

MYP *by Concept*
4&5

Geography

Louise Harrison
Robbie Woodburn





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4&5



Geography

Louise Harrison

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Series editor: Paul Morris

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How to use this book

Welcome to Hodder Education's *MYP by Concept* series! Each chapter is designed to lead you through an *inquiry* into the concepts of geography, and how they interact in real-life global contexts.

The *Statement of Inquiry* provides the framework for this inquiry, and the *Inquiry questions* then lead us through the exploration as they are developed through each chapter.

KEY WORDS

Key words are included to give you access to vocabulary for the topic. **Glossary terms** are highlighted and, where applicable, **search terms** are given to encourage independent learning and research skills.

As you explore, activities suggest ways to learn through *action*.

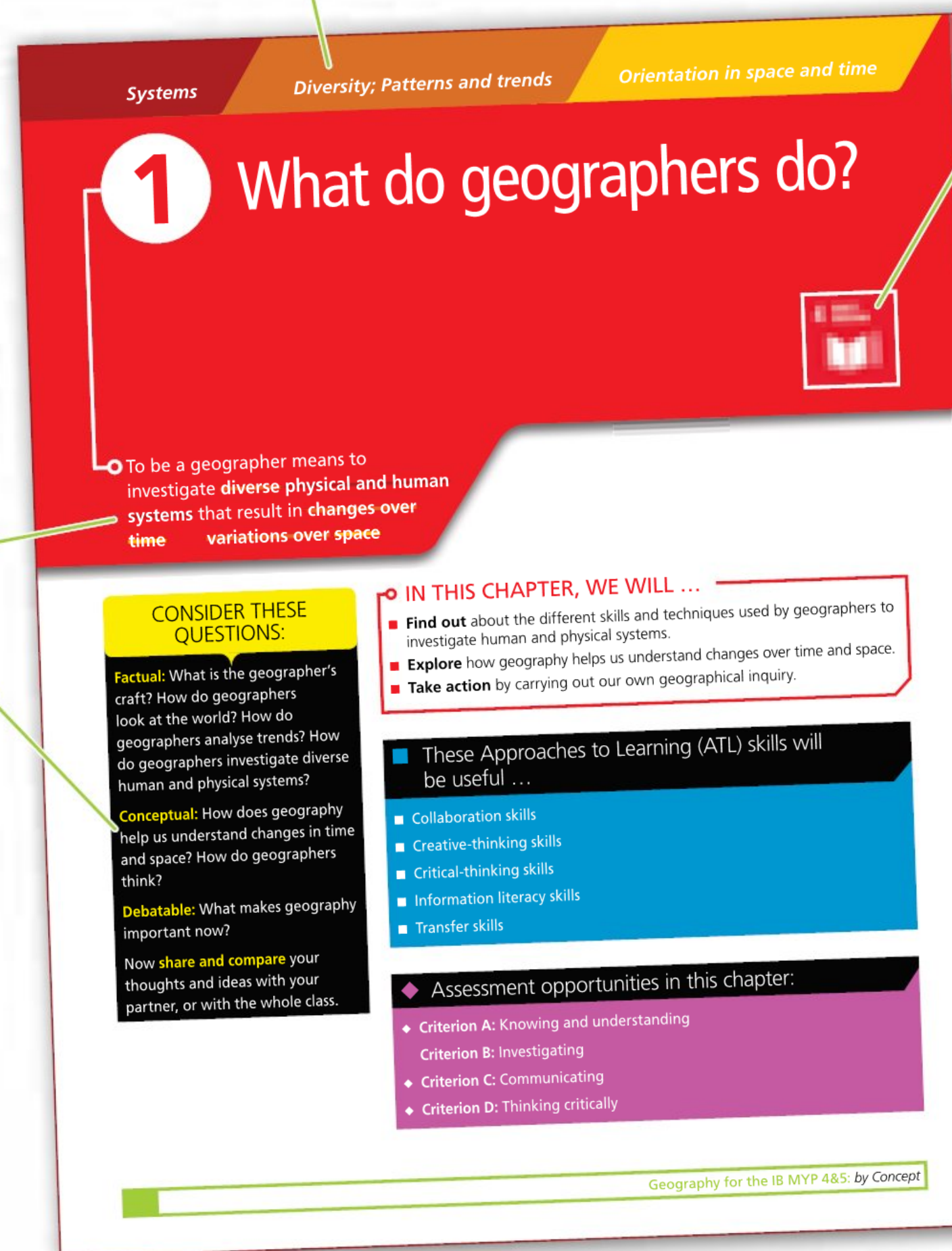
■ ATL

Activities are designed to develop your *Approaches to Learning* (ATL) skills.

◆ Assessment opportunities in this chapter

Some activities are *formative* as they allow you to practise certain parts of the MYP Geography *Assessment Objectives*. Other activities can be used by you or your teachers to assess your achievement *summatively* against all parts of an assessment objective.

Each chapter is framed with a *Key concept* and a *Related concept* and is set in a *Global context*.



Key *Approaches to Learning* skills for MYP Geography are highlighted whenever we encounter them.

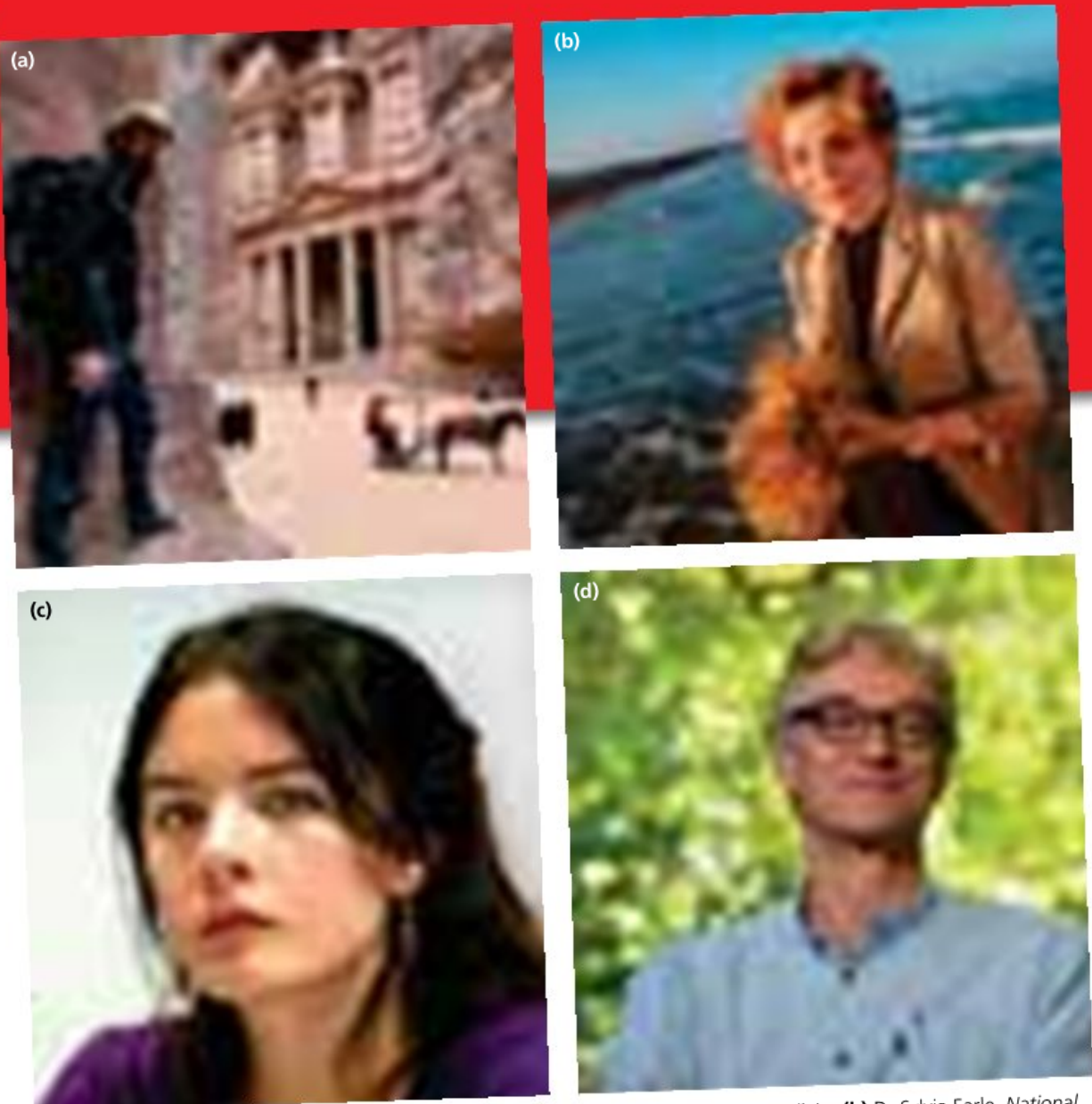
Hint

In some of the activities, we provide hints to help you work on the assignment. This also introduces you to the Hint feature in the on-screen assessment.

EXTENSION

Extension activities allow you to explore a topic further.

The United Nations Sustainable Development Goals (UNSDG) logos show which goal or goals relate to each chapter.



■ **Figure 1.1** Famous geographers: (a) explorer and geography teacher Fearghal O'Nuallain, (b) Dr Sylvia Earle, *National Geographic* explorer-in-residence, (c) Camila Vallejo, member of the Chilean parliament and geographer, (d) Nicholas Crane, English geographer, explorer, writer and broadcaster

● We will reflect on this learner profile attribute ...

● Inquirer – we will develop skills for inquiry and research.

KEY WORDS

analysisgeographer

investigation skill

! Take action

! While the book provides opportunities for action and plenty of content to enrich the conceptual relationships, you must be an active part of this process. Guidance is given to help you with your own research, including how to carry out research, guidance on forming your own research question, as well as linking and developing your study of geography to the global issues in our twenty-first-century world.

You are prompted to consider your conceptual understanding in a variety of activities throughout each chapter.

We have incorporated Visible Thinking – ideas, framework, protocol and thinking routines – from Project Zero at the Harvard Graduate School of Education into many of our activities.

▼ Links to

Like any other subject, geography is just one part of our bigger picture of the world. Links to other subjects are discussed.

● We will reflect on this learner profile attribute ...

- Each chapter has an *IB learner profile* attribute as its theme, and you are encouraged to reflect on these too.

Finally, at the end of the chapter, you are asked to reflect back on what you have learnt with our *Reflection table*, maybe to think of new questions brought to light by your learning.

Use this table to evaluate and reflect on your own learning in this chapter					
Questions we asked	Answers we found	Any further questions now?			
Factual					
Conceptual					
Debatable					
Approaches to learning you used in this chapter	Description – what new skills did you learn?	How well did you master the skills?			
		Novice	Learner	Practitioner	Expert
Learner profile attribute(s)	Reflect on the importance of being knowledgeable for your learning in this chapter.				

1

What do geographers do?



- To be a geographer means to investigate **diverse physical and human systems** that result in **changes over time** and **variations over space**.

CONSIDER THESE QUESTIONS:

Factual: What is the geographer's craft? How do geographers look at the world? How do geographers analyse trends? How do geographers investigate diverse human and physical systems?

Conceptual: How does geography help us understand changes in time and space? How do geographers think?

Debatable: What makes geography important now?

Now **share and compare** your thoughts and ideas with your partner, or with the whole class.

IN THIS CHAPTER, WE WILL ...

- Find out** about the different skills and techniques used by geographers to investigate human and physical systems.
- Explore** how geography helps us understand changes over time and space.
- Take action** by carrying out our own geographical inquiry.

These Approaches to Learning (ATL) skills will be useful ...

- Collaboration skills
- Creative-thinking skills
- Critical-thinking skills
- Information literacy skills
- Transfer skills

Assessment opportunities in this chapter:

- ◆ Criterion A: Knowing and understanding
- ◆ Criterion B: Investigating
- ◆ Criterion C: Communicating
- ◆ Criterion D: Thinking critically



Figure 1.1 Famous geographers: **(a)** explorer and geography teacher Fearghal O'Nuallain, **(b)** Dr Sylvia Earle, *National Geographic* explorer-in-residence, **(c)** Camila Vallejo, member of the Chilean parliament and geographer, **(d)** Nicholas Crane, English geographer, explorer, writer and broadcaster

● We will reflect on this learner profile attribute ...

● Inquirer – we will develop skills for inquiry and research.

KEY WORDS

analysis
geographer

investigation
skill

What makes geography important now?



■ **Figure 1.2** Geographers explore the social and environmental context of places

WHAT MAKES YOU SAY THAT?

What is going on in the photo in Figure 1.2 and what do you think it might show about the purpose of studying geography? What makes you say that?

Geographers explore the natural world and investigate the interactions between people, places and the planet. They study people (human geography) and the environment (physical geography), drawing on a range of disciplines from the social sciences and the natural sciences. Geographers add to the understanding of the Earth's social and environmental issues by examining the interconnections of different places and spaces.

ACTIVITY: Significant geographers

■ ATL

- Information literacy skills: Access information to be informed and inform others

- 1 Individually, research and **identify** a significant geographer from a time period of your choice. Search online using the term: **famous geographers**. Investigate what their main area of research is or was and what they discovered. What was their legacy? What have they helped us to discover about our world?
- 2 **Present** your findings in one of the following ways:
 - An obituary for an historical geographer
 - A pen portrait of a contemporary geographer
 - An online encyclopaedia entry
- 3 Reflect on your research. As a class or in pairs, **discuss** and **compare** the lives of the geographers you researched. What did they have in common? What made them geographers?
- 4 **Summarize** your discussion around some of the IB Learner Profile attributes such as: How are geographers inquirers, balanced, risk-takers, communicators and so on?

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding.

ACTIVITY: A geographer's toolkit

■ ATL

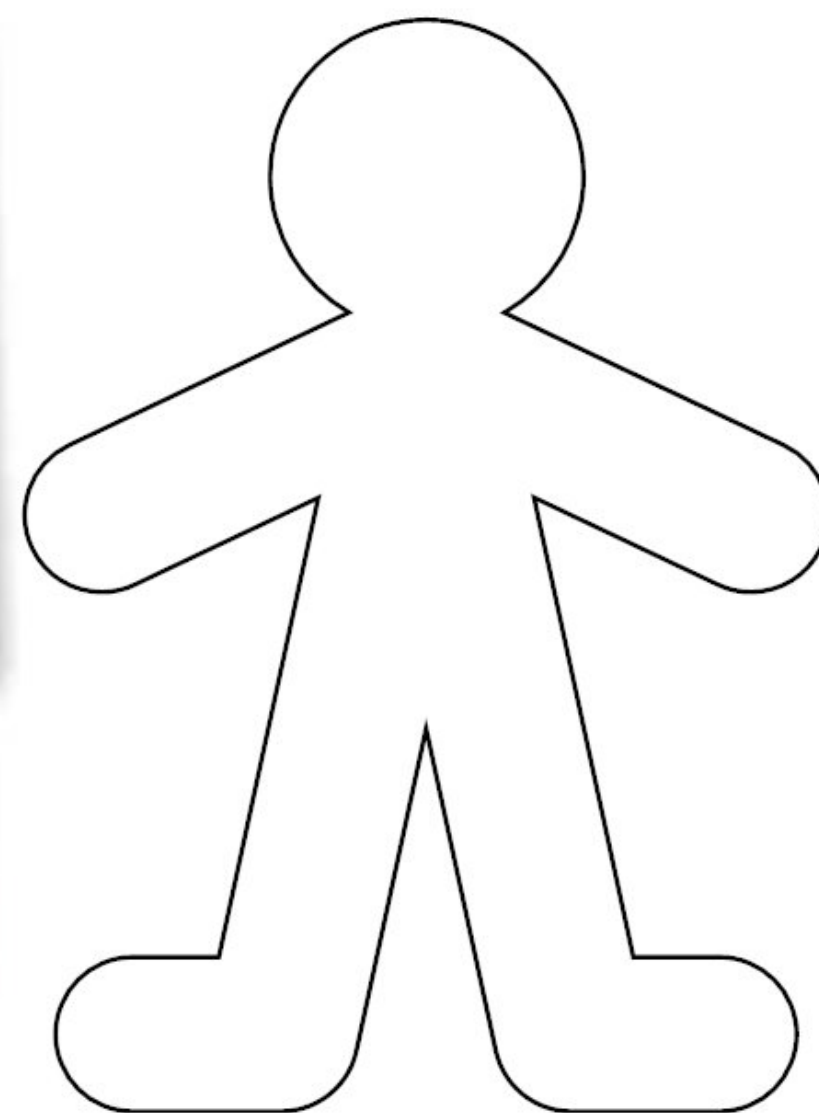
- Information literacy skills: Make connections between various sources of information

Look at the photos that show geographers and geography students doing typical geographical tasks.



■ **Figure 1.3** Geographers doing typical geographical tasks

- 1 List the skills needed to complete all the tasks shown in Figure 1.3.
- 2 Draw a copy of the geographer outline in Figure 1.4. Annotate your outline with the skills listed in Question 1. You will need to pay particular attention to the skills that require the use of our five senses: touch, taste, sound, smell, and sight. You may also want to add annotations that refer to the specific kit needed to carry out certain tasks.



■ **Figure 1.4** Geographer outline

- 3 In groups, discuss the similarities and differences between your annotated outlines and try to agree on a list of the skills needed by geographers.
- 4 Discuss as a class and determine a final list. You could then make a final version of your annotated geographer outline for displaying or create a document summarizing essential geographical skills.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding.

What is the geographer's craft?



■ **Figure 1.5** Direct observations

HOW DO GEOGRAPHERS LOOK AT THE WORLD?

How would you describe the world around you? Most people can see but not many people can observe. Show a person a photograph and they might describe some elements of it: the sky is blue, or the vegetation is green. Show a skilled geographer the same image and they will give you a detailed description of what can be found in the picture and the reasons for it. Geographers are always observing and asking the where, what, who, when and why about places they see.

DISCUSS

In pairs, **discuss** what you think makes geographers well equipped to analyse a photo like that in Figure 1.6. Consider how geographers would use their understanding of physical or human geography to **interpret** the photograph.



■ **Figure 1.6** The ruined interior of a bank after a volcanic eruption in Plymouth, Montserrat

ACTIVITY: Virtual field sketching

■ ATL

- Creative-thinking skills: Create original works and ideas

What is your goal?

Your goal is to **interpret** a landscape, whether physical or human, by examining the inter-related elements of an environment to decide which ones are more important than others.

How will you achieve this?

- 1 Working in pairs, use Google Street View to find a suitable location of interest for you and your partner. This could be a place you are studying in your geography class or it could be a location where you have been or you would like to visit.

Hint

Make sure you keep the view at street level as you want to draw your sketch as if you were standing there.

- 2 Before you start, individually reflect on the purpose and value of the sketch you are about to draw. Try not to share your ideas at this point. This will guide you on the most relevant aspects to include in your sketch. Depending on the theme you are investigating, you may want to accentuate some features more than others.
- 3 Draw a frame inside which you will draw your sketch. It should fill at least one-third of a page. Start your sketch by drawing features that are in the background, the furthest away from the camera viewpoint, then move on to the features in the middle ground and finally things that are in the foreground. You need to include specific, small-scale features as well as the larger, more general features (see Figure 1.7b for an example).

(a)



(b)



■ **Figure 1.7 (a)** The Seven Sisters chalk cliffs in East Sussex, UK and **(b)** a sketch of the same chalk cliff photograph

- 4 Add annotations on the main features of your sketch, keeping in mind the purpose and value of your drawing.
- 5 Now, swap your sketch with your partner. **Compare and contrast** the same scene. Reflect on the following points:
 - To what extent have you drawn similar features and used similar annotations?
 - How can you explain the similarities and differences?
- 6 Discuss your findings as a class.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.

Photographic interpretation

Interpreting photographs is an important skill for geographers. It helps to give a sense of place and sets pictures in given geographical contexts instead of using pictures as simple illustrations showing what a space looks like. Finding out what a place is like connects the geography to human existence, experiences and interactions. The most effective technique to **interpret** a photograph is to use the five Ws:

- Who: Who is in the photograph?
- What: What is shown in the photograph?
- Where: Where is the photograph of?
- When: When was the photograph taken (what is the timescale or the time period)?
- Why: Why does the place look like this?

The technique can be fine-tuned by asking which questions are more significant than others and why.



THINK–PAIR–SHARE

Think: How would you **define** a map?

Think about the definition on your own and then share your thoughts with a partner.

Use the Oxford online dictionary to **explore** the various definitions of 'map':

<https://en.oxforddictionaries.com/>

Now share your conclusions as a class.

MAPS: THE SCIENCE OF PLACE AND SPACE

Maps are the primary tools of geographers. Essential information about time, place and space can be deduced from maps. Maps allow geographers to examine **spatial** relations which consist of the links that people and places have to one another because of their location. The aim of map analysis is to identify **patterns** and processes, detect anomalies, test hypotheses and theories, and generate located data and knowledge. However, maps – whether printed or to some extent digital – are only a snapshot of certain areas at a certain time. Most printed maps are out of date when they are published and not all digital maps are updated uniformly. A careful evaluation of map sources is essential before attempting any map interpretation and analysis. In the following activity, you will have the opportunity to evaluate a wide range of map sources.



■ **Figure 1.8** A topographic map

ACTIVITY: How valuable are maps?

■ ATL

- Information literacy skills: Make connections between various sources of information
- Critical-thinking skills: Analyse complex concepts and projects into their constituent parts and synthesize them to create new understanding

What is your goal?

Your goal is to use different **base maps** from Google Maps to **explore** the value of using maps by answering a series of inquiry questions.

How will you achieve this?

Working individually or in pairs, you will need:

- a device with an internet connection
- a web browser
- optional: a 'traditional' printed map
- a copy of the inquiry table template (Table 1.1) for recording your findings.

Task 1: How do maps show wilderness?

- 1 **Explore** how 'wild' the landscape of your place is (this could be your school or home) compared to La Grave, a small village in the Hautes-Alpes area in France.
- 2 Search online for the definition of **wilderness**. Write your own definition in the inquiry table.
- 3 Go to: www.google.com/maps/
- 4 Click on the three horizontal bars on the top left menu next to the search field. Select the third base map down called *Terrain*.
- 5 Now search for **La Grave** on Google Maps and zoom in by clicking on the '+' on the bottom right so the **scale bar** is at 1 km.
- 6 **Examine** the level of wilderness on the map by observing features such as the:
 - number of roads
 - number of settlements
 - distance between settlements (for this you need to right click on the mouse and select the *Measure distance* tool)
 - relative amount of vegetation (for this you could estimate the percentage of the map with vegetation cover)
 - steepness of the land (for this you could count the number of **contour lines** in one-quarter or one-eighth of the map).

Inquiry question (IQ)	Definitions (MYP Geography key concept or key term)	Observations	Map evidence	Evaluation (How useful is the map in answering the IQ?)
How do maps show wilderness?				
How do maps show the main functions of a settlement?				
Your own inquiry question				

Table 1.1 Inquiry table template

- Record your findings in the table template.
- Repeat steps 5 and 6 for your home location.
- Optional: you could **investigate** another location using printed maps if you have them. Search online for **map skills** to learn more about how to use printed maps.
- Make sure you **identify** the map evidence and that you **evaluate** the usefulness of the map.

Task 2: How do maps show the main functions of a settlement?

- Explore** how the settlement functions of your place (this could be your school or home) compared to those of La Grave.

- Search online for the definition of **settlement function**. Write your own definition in the inquiry table.
- Go to: www.google.com/maps/
- Click on the three horizontal bars on the top left menu next to the search field. Select the first base map down called *Map*. You may find switching to the *Satellite* base map useful.
- Examine the main function of the area on the map using the flow chart below (Figure 1.9)
- Record your finding in the table template.
- Repeat steps 4 and 5 for your home location.
- Make sure you **identify** the map evidence and that you **evaluate** the usefulness of the map.

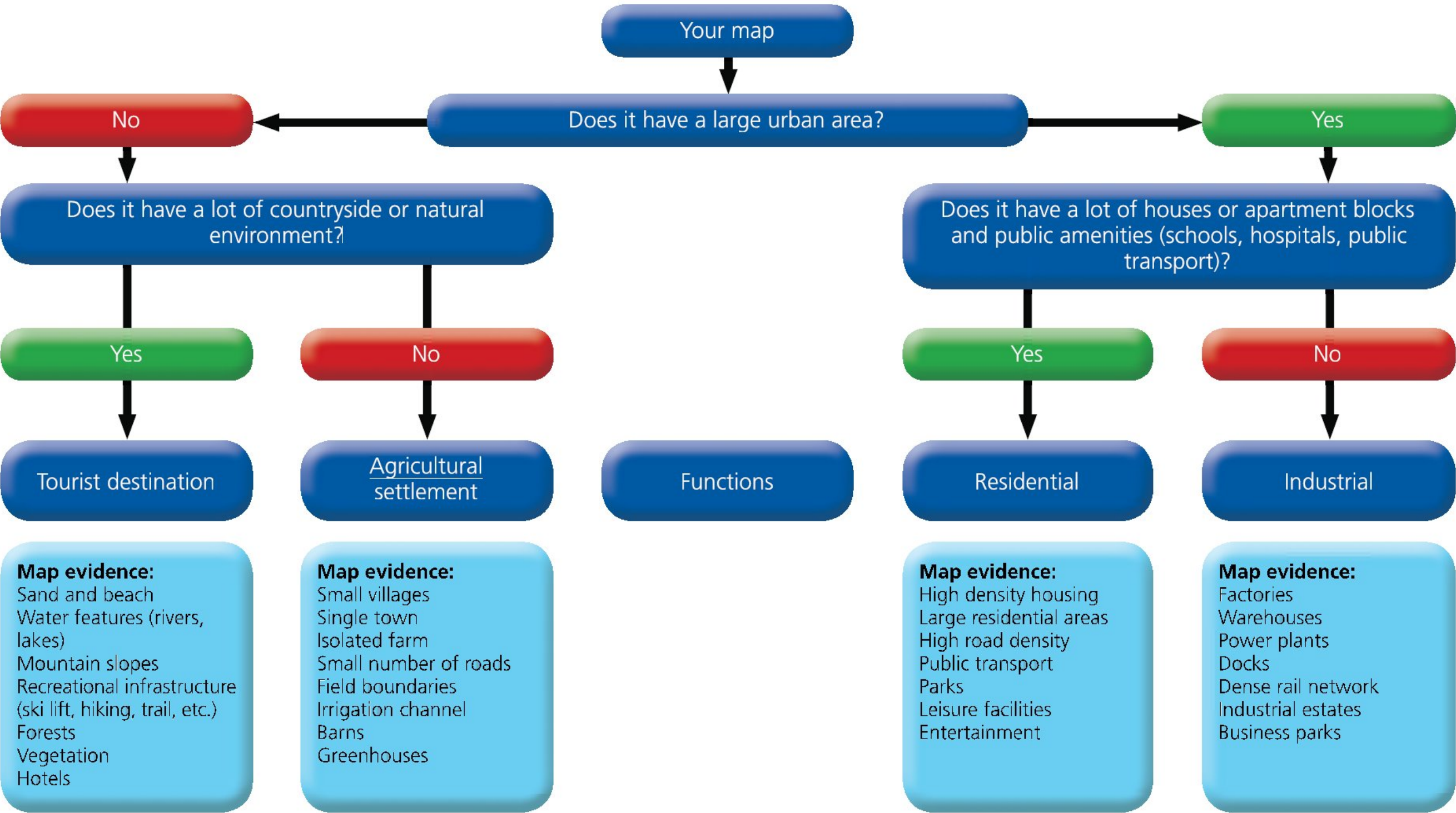


Figure 1.9 Settlement functions flow chart

Task 3

Formulate your own inquiry question to **investigate** your home location and another location of your choice. Use a range of map skills to help you **find** map evidence for answering your question. Make sure you record your findings in the table.

In a conclusion, **summarize** your findings for each activity. **State** whether you were able to answer the three inquiry questions. **Discuss** your findings with a partner.

Evaluate your investigation. Could you have improved your use of map skills or map evidence? **State** improvements you could have made.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.

DISCUSS

In pairs, **discuss** the value of creating sketch maps and field sketches in the age of digital technology.

Map making has always been a tool of the trade for geographers. In medieval times, all maps were drawn by hand, which made their distribution rather limited. The use of maps became more popular with the innovation of the printing machine in the fifteenth century. In the activity on page 11, you are going to **create** your own sketch map in the old way, by hand, using just a pencil and a piece of paper. Later in this chapter, you will discover how to design industry standard maps using the technology of Geographic Information Systems (GIS) (see page 18).

Sketch mapping is an effective way of synthesizing concepts and factual information learnt in class for specific locations and case studies. You can take full ownership of the information on your sketch map and can use your map as supportive evidence for your investigations, reports or essays.

HOW DO GEOGRAPHERS ANALYSE TRENDS?



■ **Figure 1.10** A humorous look at the use of charts in the workplace, from www.CartoonStock.com

DISCUSS

In pairs, **discuss** what you think the cartoon in Figure 1.10 tells us about the strengths and limitations of using graphs and charts.

We have seen earlier in this chapter how geographers can employ *qualitative skills* when interpreting the landscape while in the field or when analysing pictures and maps. There are also occasions when *quantitative skills* are needed, for example when analysing graphs and carrying out statistical calculations. The data from graphs can be interpreted to extract and simplify essential information. Graph analysis is also commonly used by geographers to make forecasts (see Figure 1.12). In the activity on page 12, you will learn how to use the TEA structure to describe global trends in the number of birth and deaths until 2100.

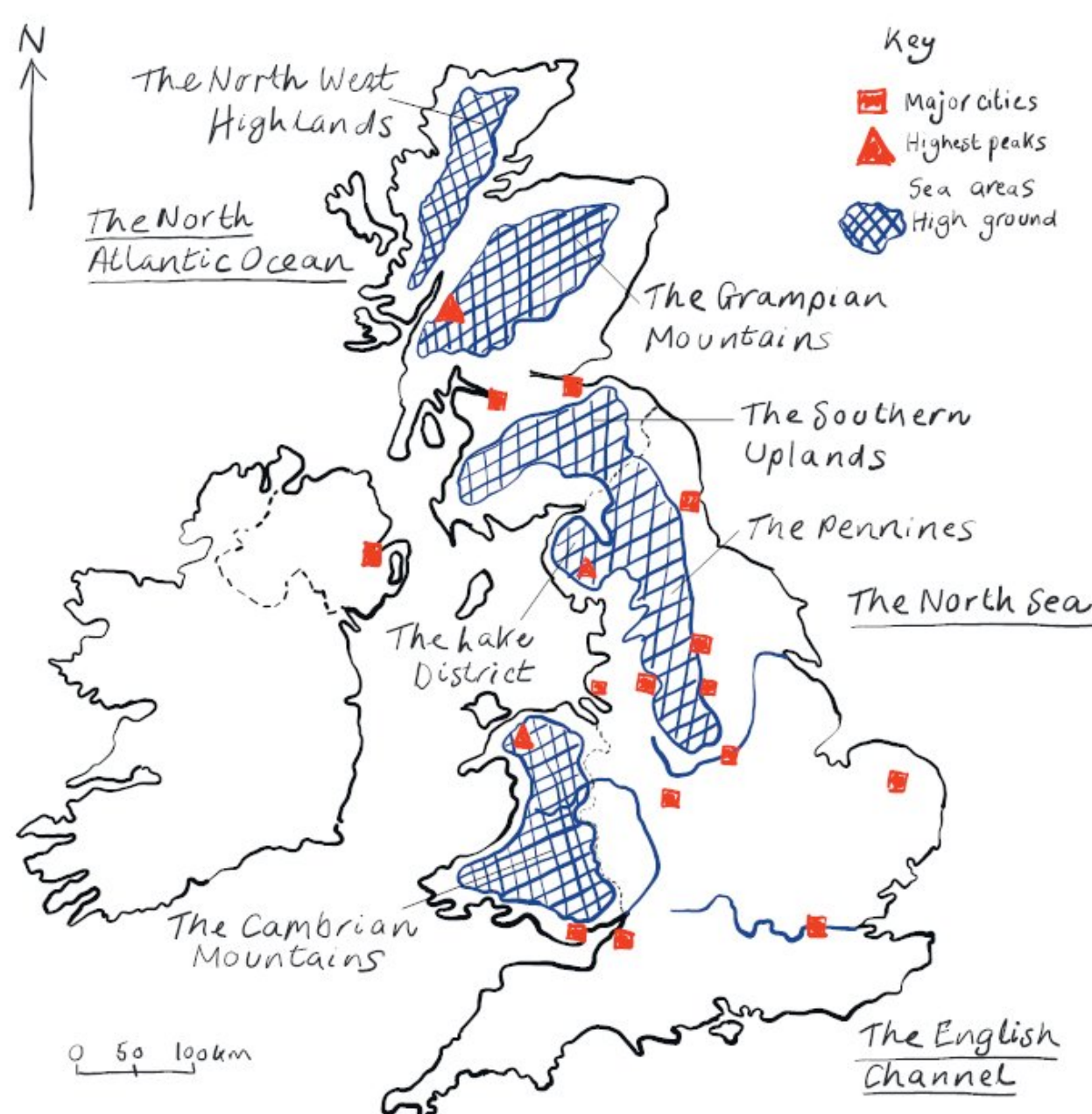
ACTIVITY: Sketch mapping

■ ATL

- Transfer skills: Combine knowledge, understanding and skills to create products or solutions

Remember that maps do not show the real world; they are filtered representations of reality. Sketch maps therefore show an even more simplified version of reality (see Figure 1.11). They are a quick and simple way of recording spatial relationships between places and spaces.

You will need to choose the location to **sketch** a map from. This could be your school site, which would make comparisons of sketches in the class more meaningful, or it could be a case study you have learnt about in your geography class.



■ **Figure 1.11** A sketch map of the UK

- 1 Imagine that you are a bird flying over the area that you are about to draw (or use Google Maps instead). **Identify** the features you want to record on your map. This will largely depend on the theme, concept or issue you want to exemplify with your sketch map.
- 2 **Draw** a box on a piece of paper that will include the features you want to record. It should fill at least one-third of a page.

- 3 Before adding the features of your chosen theme, you need to add the main physical and human features of your site that **distinguish** it from other locations. Think about features that make your location visually different from other locations. It could be the shape of a coastline, the crest of mountains, the course of a river or an estuary or the position of major vegetated areas such as forests, marshes or any other noticeable natural spaces. Do not forget to add any main human features such as the outline of settlements and identifiable land use zones, roads and motorways, railway lines and any noticeable linear infrastructures.
- 4 In some cases, it is more efficient to draw these physical and human features or to use a symbol that is explained in a key on your map. In other cases, it is easier to **describe** certain features in writing, especially if what you want to show is not visual. You can then use abbreviations and acronyms. Do not forget to give full explanations of abbreviations or symbols you have used in the key.
- 5 Then, you can add the final 'layer' of information on to your sketch map to make your map 'speak'. This is often in the form of short written annotations with arrow heads pointing accurately at the feature you are describing or commenting on.
- 6 The final step is to make sure you **STACK** your map:
 - **Scale** – Show the scale as a scale bar. If you don't know the scale, write 'Not to scale'.
 - **Title** – The title should be linked to the theme, concept or issue your map is illustrating.
 - **Accuracy** – Make sure that your map keeps relative proportions between all the features.
 - **Compass** – Maps always have the north arrow pointing towards the top of the map/page.
 - **Key** – The key is essential for allowing your audience to understand the meaning of your map.
- 7 In pairs, **evaluate** each other's maps. **Discuss** the strengths and the limitations of your partner's map.

◆ Assessment opportunities

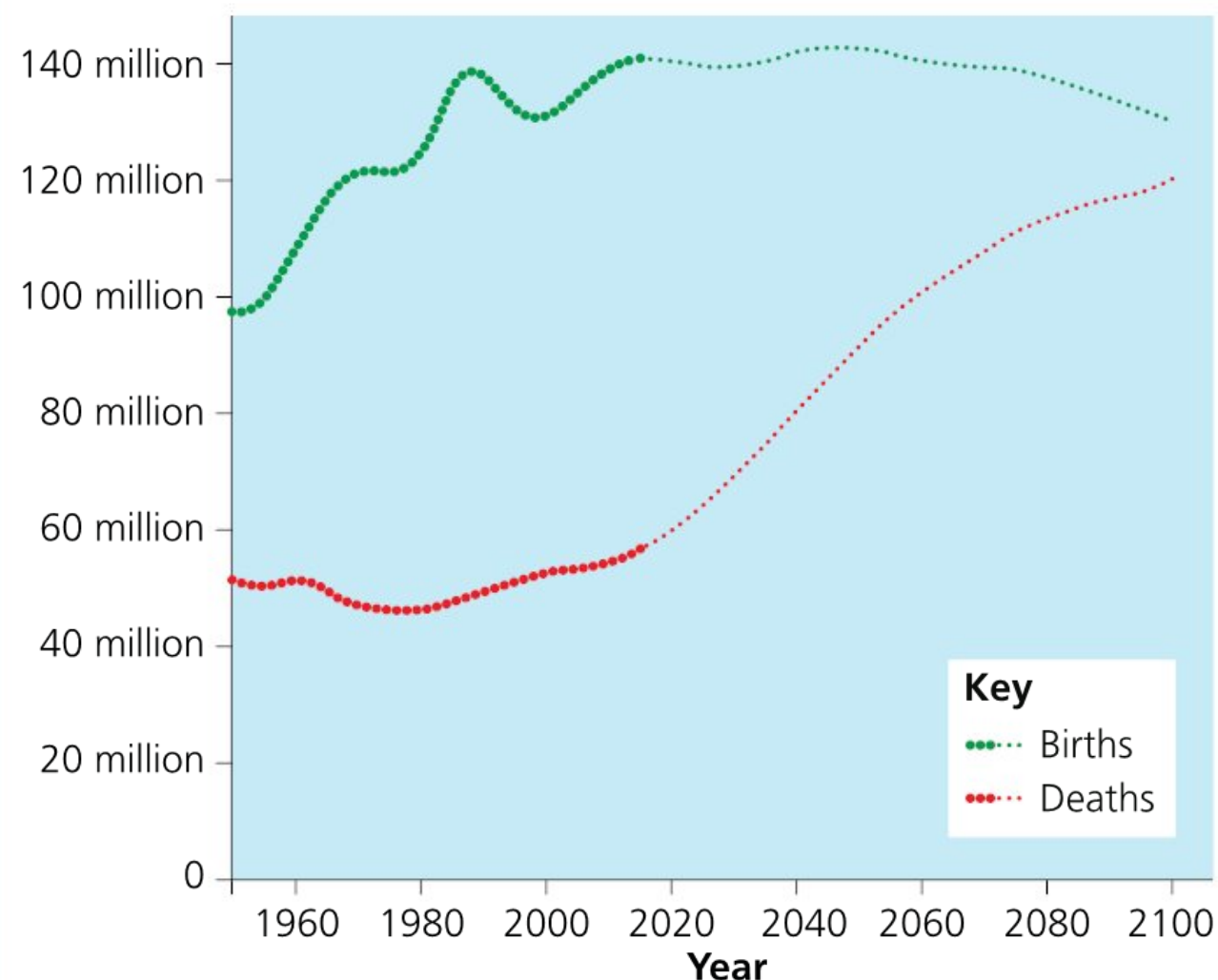
- ◆ This activity can be assessed using Criterion C: Communicating and Criterion D: Thinking critically.

ACTIVITY: Describing trends

■ ATL

- Critical-thinking skills: Practise observing carefully in order to recognize problems

Use the TEA structure to **describe** the graph in Figure 1.12. You could also **describe** any graph of your choice using the same technique.



■ **Figure 1.12** The annual number of births and deaths in the world, including the UN projections until 2100

Trend – What is the overview of the graph? What are the changes and movements in data or figures over a period of time?

Various words can be used to **describe** trends.

Downward movement (verbs)

Decline
Decrease
Drop
Fall
Slide
Lose ground
Crash
Collapse
Plummet
Plunge
Weaken

Upward movement (verbs)

Climb
Rise
Increase
Surge
Soar
Gain
Jump
Strengthen

Stability (verbs)

Flatten out
Hold steady
Stabilize
Level off
Plateau
Recover

Degree of change, speed or rate (adjectives)

Slow
Perilous
Disastrous
Sharp
Steady
Rapid
Massive
Gradual
Slight

■ **Figure 1.13** Words to describe trends

Examples – Quote figures from the graph to support your description of the trend, including data examples if these are available on the graph.

Anomaly – Mention any gaps in a bar graph, peaks and troughs in a line graph or outliers in a scatter graph.

◆ Assessment opportunities

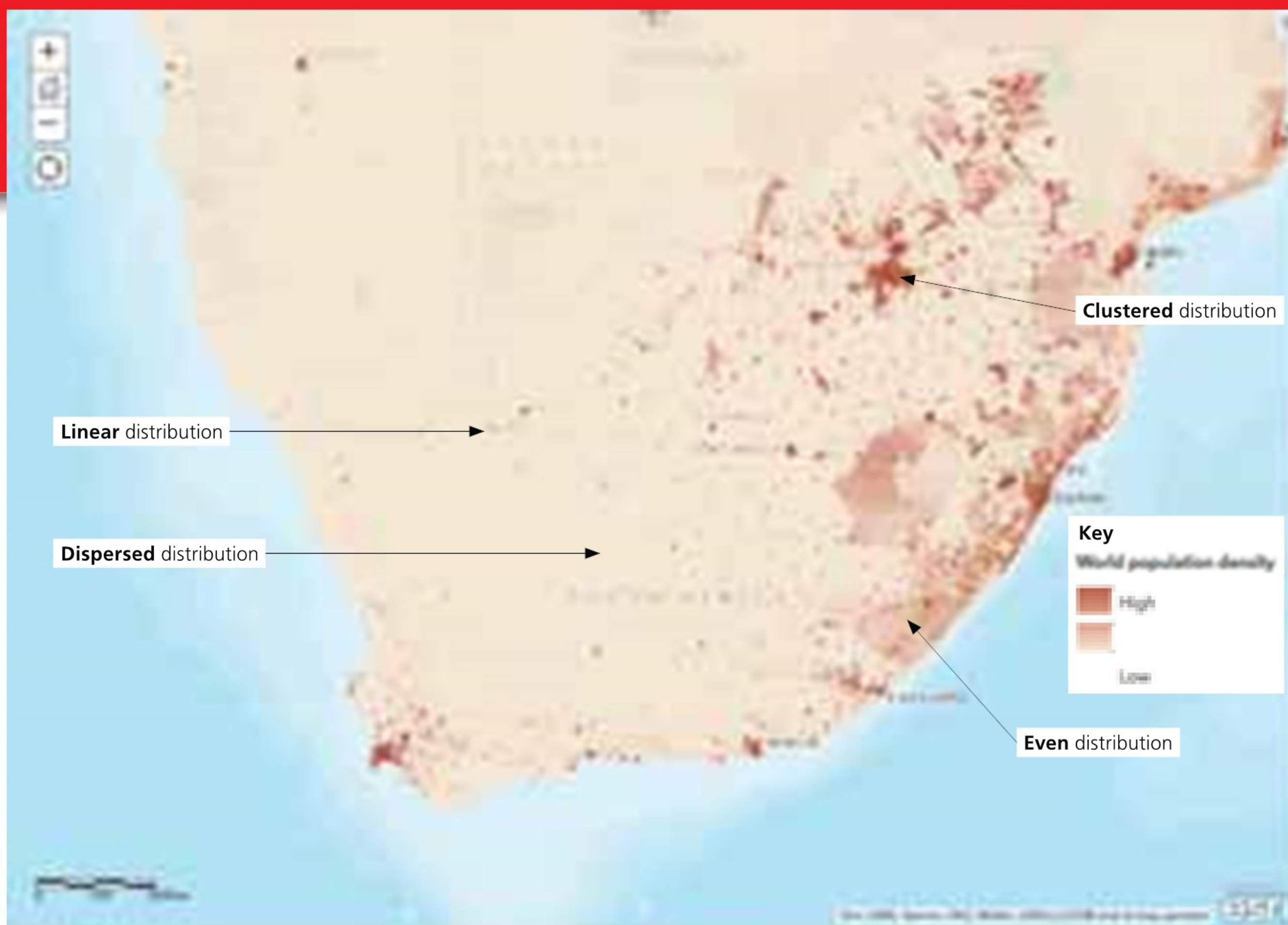
- ◆ This activity can be assessed using Criterion D: Thinking critically.

The TEA structure is equally applicable for describing maps. The 'trend' on a map is called a pattern. The pattern concerns the distribution of features in a certain space. The distribution is a description of where things are on a map. This could be physical features, for example, where lakes and rivers are located in a certain area, or human features such as population distribution (see Figure 1.14).

Simple descriptive statistics are widely used by geographers in order to perform quantitative analysis. They include the:

- **mean** or average
- **range** – the difference between the maximum and the minimum
- **mode** – the most frequently occurring number, group or class
- **median** – the middle value when all the numbers are placed in ascending or descending rank order.

The use of descriptive statistics is straightforward and can be easily combined with other qualitative description of graphical representation of data when carrying out an investigation (see Take action: Conducting an enquiry on page 25). The next activity will guide you on how to analyse scatter graphs.



■ **Figure 1.14** Population density in South Africa

ACTIVITY: Analysing scatter graphs

■ ATL

- Critical-thinking skills: Identify trends and forecast possibilities; Interpret data; Test generalizations and conclusions

You are going to **create** a scatter graph. First decide whether you are going to work on paper or use a spreadsheet on a computer. **Plot** the data from Table 1.2 on your graph to show the relationship between **Gross Domestic Product (GDP)** and life expectancy.

Analyse your graph with reference to the type of correlation, line of best fit and outliers.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.

Country	GDP/head in \$ (x-axis)	Life expectancy (y-axis)
Bangladesh	1,359	72
Brazil	8,639	76
Cameroon	1,392	58
Canada	42,349	82
China	8,117	76
Czech Rep	18,484	78
Finland	43,433	82
Greece	17,852	81
India	1,717	69
Saudi Arabia	19,982	75
South Africa	5,280	63
South Korea	27,608	82
Turkey	10,863	76
UK	40,412	81

■ **Table 1.2** Development data for selected countries
Source: The World Bank (2016)

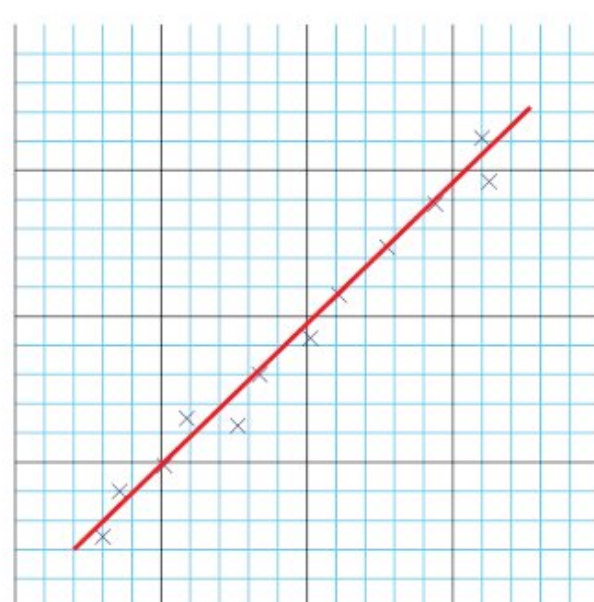


Scatter graphs

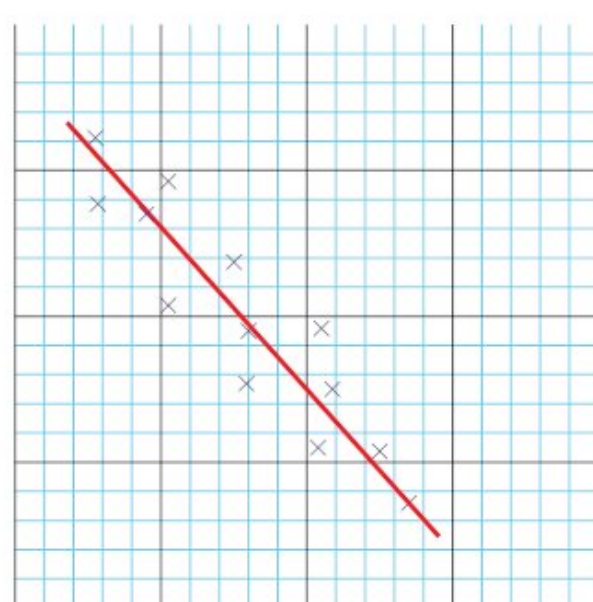
A scatter graph shows the relationship between two variables by the distribution of dots. It is usual that the **dependent variable** is placed on the y-axis (vertical), and the **independent variable** on the x-axis. Dots are **plotted** on the graph using the two sets of data as coordinates. The arrangement of dots can then be **examined** to see if there is a positive relationship (as one variable increases so does the other), a negative relationship (as one variable increases the other decreases) or no relationship (there is no recognisable pattern to the distribution of dots). A best-fit line is drawn that comes close to as many points as possible. The strength of the relationship between two variables is called a correlation. If the points on the

scatter graph lie close to or on the line of best fit then the correlation is strong. The further the points are from the line of best fit, the weaker the correlation.

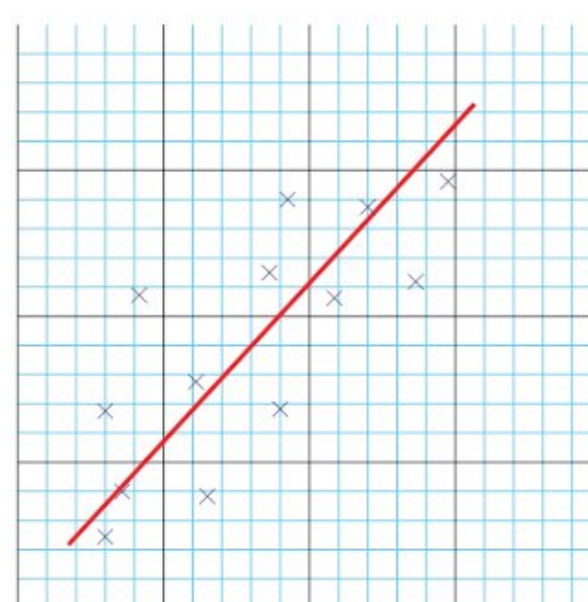
- Positive correlation – the values of both variables increase and the line of best fit goes up from the bottom left corner to the top right corner of the graph.
- Negative correlation – the values of the independent variable increase while the values of the dependent variable decrease and the line of best fit goes down from the top left corner to the bottom right corner of the graph.
- No correlation – there is no clear tendency for the values of the two variables to move in any particular direction.



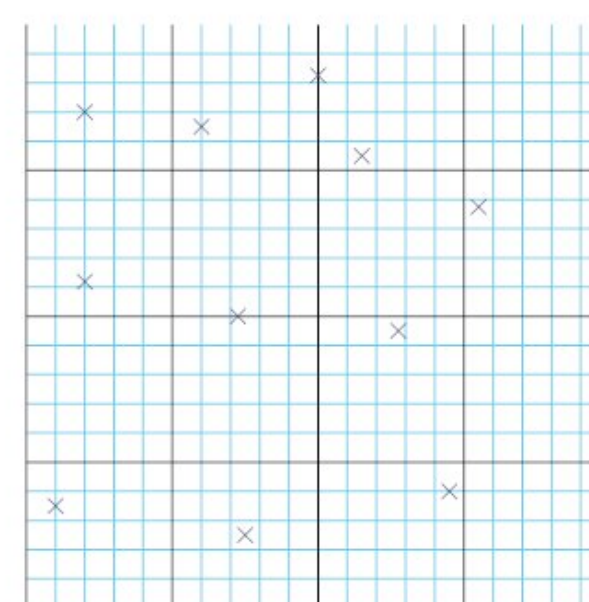
Strong positive correlation



Strong negative correlation



Weak positive correlation



No correlation

■ **Figure 1.15** Types of correlation and associated scatter graphs

DISCUSS

'Statistics are only an aid to analysis and no more.'

To what extent do you agree with this statement?

Discuss with reference to the quantitative and qualitative skills used in geography.

How does geography help us understand changes in time and space?

As we have seen, geography makes connections across a range of disciplines. It offers a unique perspective because of its contribution to unravelling complex interactions between human and natural environments. People's opinions, values and attitudes, upon which they base judgements and subsequently take actions, can result in unintended consequences for our planet. Some judgements are based on impartial, wide-ranging and detailed knowledge and understanding whereas other can be based on purely biased and stereotypical misconceptions. Geographers use techniques to critically analyse the causes and consequences of our everyday actions and in a wider sense how and why humankind is impacting the Earth. In the following activities, you will explore ATL skills such as: how to consider ideas from multiple perspectives, how to recognize unstated assumptions and bias and how to use models and simulations to explore complex systems and issues.

ACTIVITY: Conflict matrices

■ ATL

- Critical-thinking skills: Consider ideas from multiple perspectives

Conflict matrices are used to **evaluate** how different human activities, uses of resources and the economic or sentimental values attached to resources can lead to conflicts between different groups of people and users. A conflict matrix is an excellent tool to **analyse** conflicts over space as most conflicting interests are dependent on a given geographical location with specific multi-purpose uses of a resource.

Choose five different groups of users of a resource of your choice. Alternatively, you could refer to Chapters 4, 5, 6, 7 or 8 to **find** an example. The resource could be natural or human-made, and can be a location. For example, a lagoon is a location and also a resource for both tourists and local fishermen.

Identify each group and add their name or description in the user groups boxes in your copy of the matrix (Table 1.3).

Complete the empty boxes to assess the level of conflict between two users:

- If there is conflict, put a cross.
- If the two users can co-exist or use the resource without a conflict, put a tick.
- If neither, put a zero.

	Group 1	Group 2	Group 3	Group 4	Group 5
Group 1					
Group 2					
Group 3					
Group 4					
Group 5					

■ **Table 1.3** Conflict matrix

Exemplify the conflicts from your matrix by researching news articles illustrating the causes and negative and positive consequences of conflicts over resources and spaces in the world today.

Discuss your findings with a partner.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.

ACTIVITY: OPVL source analysis

■ ATL

- Critical-thinking skills: Recognize unstated assumptions and bias

Newspapers articles, news websites and official reports from national and supranational organizations are widely used as secondary information sources in geography. The constantly changing nature of people's interactions with different spaces means that there are plenty of secondary sources for investigating a geographical theme or issue. The OPVL technique is designed to critically **evaluate** the usefulness of sources. It is based on the following key questions:

Origin:

- Who created it?
- Who is the author?
- When was it created?
- When was it published?
- Who is publishing it?
- Is there anything we know about the author that is relevant to our evaluation?

Purpose:

- Why does this document exist?
- Why did the author create this piece of work?
- What is the intent?
- Why did the author choose this particular format?
- Who is the intended audience?
- What does the document 'say'?
- Can it tell you more than is on the surface?

Value:

- What can we tell about the author from the piece?
- What can we tell about the time period from the piece?
- Under what circumstances was the piece created and how does the piece reflect those circumstances?
- What can we tell about any controversies from the piece?
- Does the author represent a particular 'side' of a controversy or event?
- What can we tell about the author's perspective from the piece?

Limitation:

- What part of the story can we *not* tell from this document?
- How could we verify the content of the piece?
- Does this piece inaccurately reflect anything about the event or issue?
- What does the author leave out and why does he/she leave it out?
- What is purposely addressed?

Working in pairs, **apply** the OPVL technique either to sources you have already used in a prior investigation or to new source material for a geography theme or issue you are currently investigating in your geography class.

Hint

To make the OPVL task manageable try to **evaluate** no more than four sources and only answer one or two prompt questions from each of the OPVL categories in the list.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.

ACTIVITY: Sequencing flow, systems and landform diagrams

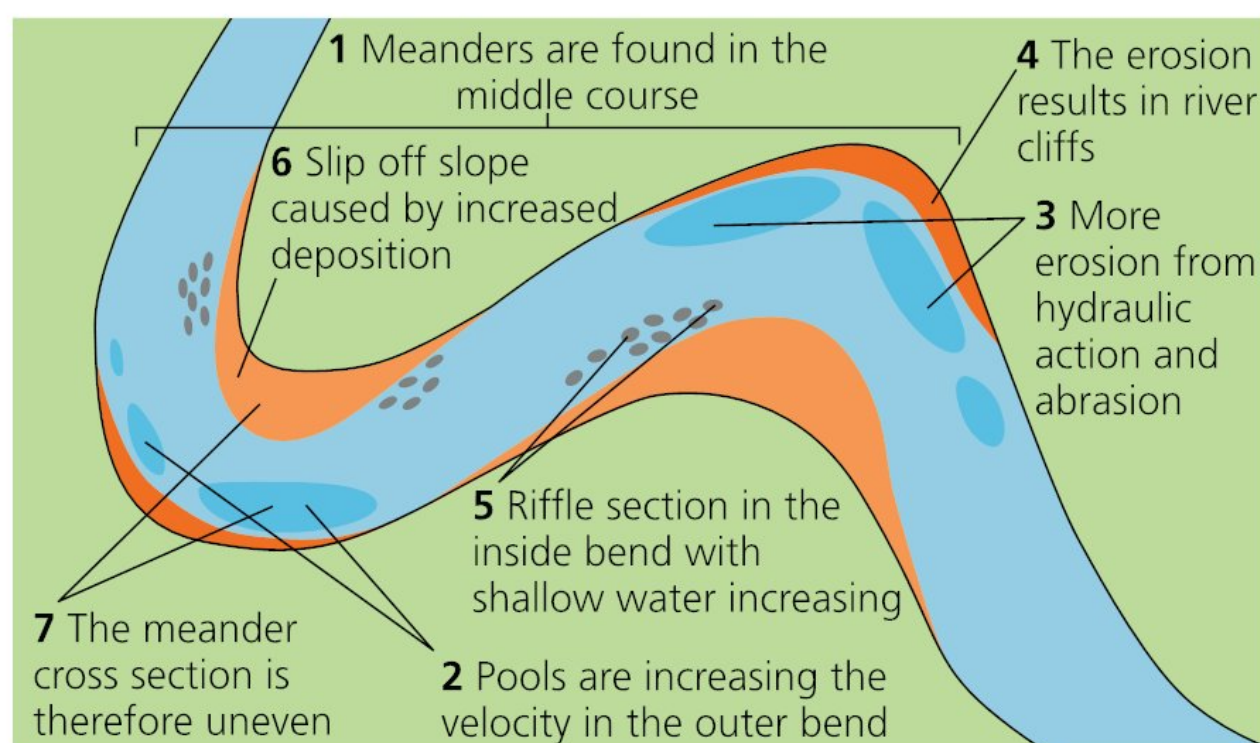
■ ATL

- Critical-thinking skills: Use models and simulations to explore complex systems and issues

In this activity, you are going to practise using the sequencing technique often employed by geographers. The technique is used to **present** the:

- causes and effects of geographical issues in flow diagrams
- components of a system in systems diagrams
- processes at play in physical geography (see Figure 1.16).

The principle is to **show** a sequence where a set of particular events or processes follow each other in a particular order over a certain timescale.



■ **Figure 1.16** The formation of a meander–sequence diagram

Working in pairs, **recall** a geographical process or issue you have learnt in your prior study of MYP Geography. This could be a process in physical environments or it could be related to human geography themes that you may have encountered when investigating examples.

Use Figure 1.17 to guide you through the steps of creating a sequence diagram.

Plan the size, design and type of diagram. You might be required to add some explanations to the actual diagram, elaborating on specific features, examples and processes, so make sure the diagram you are using is large and clear. If using one from the Internet, make sure it is free from already existing annotations.

Before going ahead with the diagram and its annotations, brainstorm or **research** as many key terms and concepts that apply to the theme or question.

If you are investigating causes and impacts for a geographical process or issue, make sure you classify the causes into physical and human and that you use the **S**ocial **E**conomic **E**nvironmental and **P**olitical (SEEP) approach for the impacts.

If you are exploring a system, your sequence diagram needs some inputs, processes and outputs. You will need to brainstorm these before starting the design.

If you are answering an '**explain**' question then make sure you think about sequencing your annotations too. Sequencing can be achieved by starting each annotation with a number so the processes or impacts are described and explained in the right order. Add the specific key terms to help focus your explanation.

Finally, make sure you use arrow heads that connect accurately to the features you **describe** or **explain**.

■ **Figure 1.17** Planning for a diagram showing a sequence

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion C: Communicating and Criterion D: Thinking critically.

How do geographers think?

We have seen earlier in this chapter that maps are one of the most essential tools for geographers. The widespread use of digital maps means that maps are also an essential part of our everyday life. We use maps mostly on our mobile devices and computers, making the most of the locational information available at the touch of a screen. Digital technology is now at the heart of **Geographic Information Systems (GIS)**. GIS has transformed the way geographical issues are investigated, analysed and critically evaluated. In the following activities, you will learn how to use essential functions from the ArcGIS Online package and how to think spatially as professional geographers do.

GIS principles

What is your goal?

Your goal is to use a Geographic Information System (GIS) to **explore** how the technology works. GIS allows users to view multiple sources of information, known as layers, on one single map and to perform **spatial analysis**.

How will you achieve this?

Working individually or in pairs, you will need:

- a device with an internet connection
- a web browser
- a Google account or a Facebook account (or, if you do not have one of these, create a free account using your school email address).

- 1 You will first need to access an ArcGIS Online account. Either create your own free individual account by following the steps below or sign in using a school account if available.
- 2 Go to www.arcgis.com/index.html and click on *Sign in*.
- 3 You can create a free account by signing in with your Facebook or Google account. Alternatively, you can register an account using the *Create a public account* button (see Figure 1.18).



■ **Figure 1.18** Registering on ArcGIS Online

- 4 Once you are on the ArcGIS Online homepage, click on the *New map* tab on the top left of the page. This will open a map window (see Figure 1.19).



■ **Figure 1.19** Map window



- 5 You are going to learn how to add a layer of information in order to **identify** an issue.
- 6 Click on *Add* and from the scroll-down menu select *Search for layers*.
- 7 Click on the *My content* tab and select *ArcGIS Online* from the bottom of the scroll-down menu (see Figure 1.20).



■ **Figure 1.20** Add layers from ArcGIS Online layer database

- 8 Now search for a layer by entering key words or a layer title in the *Search for layer* field. Search: **Coral reef bleaching**
- 9 Once the correct layer is listed, click on *Add to map* (see Figure 1.21).



■ **Figure 1.21** Add layers from ArcGIS Online layer database

- 10 Once you have added the layer, the map layer content panel should look like Figure 1.22.



■ **Figure 1.22** Add layers from ArcGIS Online layer database

- 11 Turn the layer On or Off, by unticking or ticking the layer, to **identify** which coral reef areas are the most at risk.
- 12 Alternatively, you can achieve the same action by using the *Transparency* tool (see Figure 1.23). First, you need to place the layer you want to make transparent before the second layer by dragging it and placing above at the top of the list.



■ **Figure 1.23** Selecting the *Transparency* tool

- 13 Now click on the three blue dots at the end of the layer. This opens the layer drop-down menu.



■ **Figure 1.24** Using the *Transparency* tool

- 14 Click on *Transparency*, and move the slider to the required transparency level.
- 15 In pairs, **discuss** the pattern in the distribution of coral reefs at risk. Do not forget to use the TEA structure (see page 12).

How to create custom maps with GIS



■ **Figure 1.25** Map showing the Index of Globalization created with ArcGIS Online

One of the benefits of using GIS is the ability to use **data visualization** through maps. Whether you are using your own **geolocated** primary data you collected in the field or you have found useful secondary data, it is possible to **explore** and understand your data by using the map-customizing tools of GIS. In ArcGIS Online, you can do this by using the *Change style* tool as follows (steps 1–7):

- 1 You will need to have added a layer first with useful data related to the theme you are exploring. In this demonstration, we will **explore** the different types of globalization as investigated in Chapter 7 (see pages 154–61). The layer titled *Dimensions of Globalization – background data* has been added to a new map as instructed in the GIS Activity on page 18 (Figure 1.19). To learn how to add a layer, refer back to page 19.



■ **Figure 1.26** Dimensions of Globalization – background data layer

- 2 The map does not show any data yet and it is blank by default. To show useful data, you need to click on the *Change style* icon underneath the layer title (see Figure 1.27).



■ **Figure 1.27** Changing style

- 3 The *Change style* option allows you to select the *Attribute* (the data) you want to show on your map. Click on the drop-down menu next to *1 Choose an attribute to show* and select your data. In the example, we are selecting *Glob_index* (for Global index of Globalization) (see Figure 1.28).



■ **Figure 1.28** Changing attribute



- 4 ArcGIS Online will choose automatically the map symbol for the data to visualize but sometimes it is not the most appropriate. In this example, the default proportional circles are not suitable as they overlap, making it difficult to observe a clear global pattern (see Figure 1.29).



■ **Figure 1.29** Default map symbols

- 5 You will need to change the style to a type that allows you to see the individual countries. For this, you need to select a new map symbol by clicking on the blue *Select* button of the *Counts and Amounts (colors)* instead of the default *Counts and Amounts (size)*. By doing this, you will change the map to a **choropleth map**. If you wish to change the colour, you need to click on the blue *Options* button, where it is possible to choose another range of colours (see Figure 1.30).



■ **Figure 1.30** Changing to a choropleth map

- 6 Once you have clicked on *Options*, you will get a new screen as in Figure 1.31.



■ **Figure 1.31** Changing colour on a choropleth map

- 7 Now click on the *Symbols* icon and you can choose a different colour range for your map (see Figure 1.32).



■ **Figure 1.32** Colour select tool

Once you are happy with your new choropleth map, do not forget to click on the blue *OK* button and then click on the blue *Done* button (see Figure 1.33).



■ **Figure 1.33** Saving the new choropleth map





- 8 You have now created a new layer on your GIS map. Before you can add another layer with a new attribute and a new map symbol, it is important to name the layer you have just created with the name of its attribute. To do this, click on the three little blue dots at the end of your layer (the one with the tick) to get the *More options* drop-down menu (see Figure 1.34).



■ **Figure 1.34** Renaming a new layer

- 9 Click, and then on the drop-down menu, click on *Rename* and give your layer its name, in this case 'Global index' (see Figure 1.35).



■ **Figure 1.35** Renaming a new layer

Now you have got a layer called 'Global index' (see Figure 1.36).



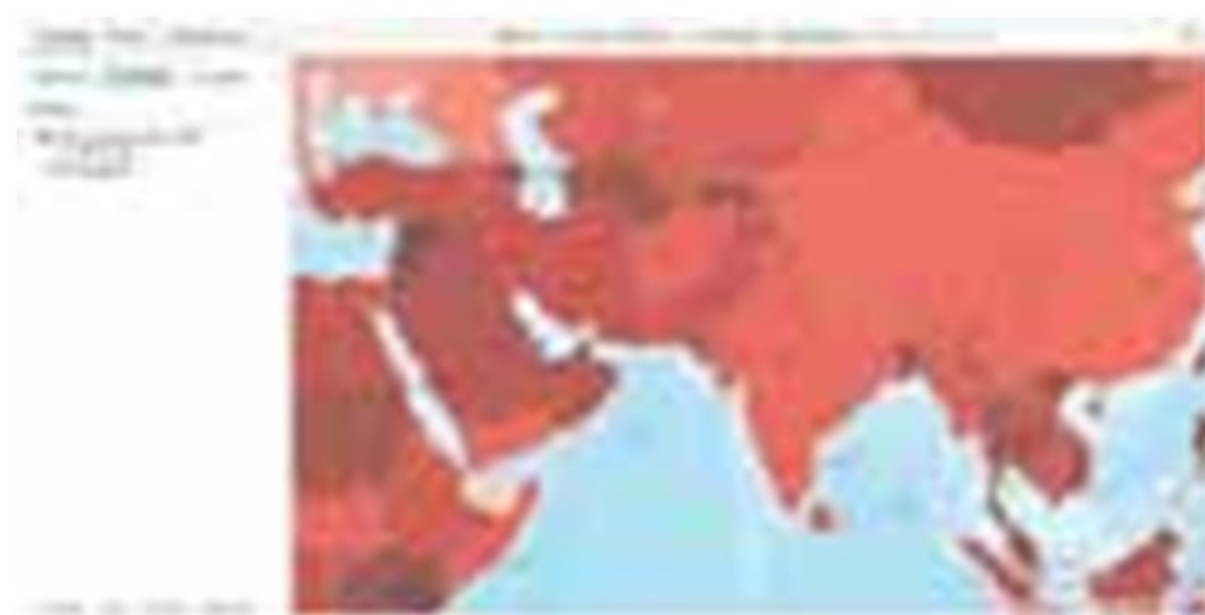
■ **Figure 1.36** New named layer

- 10 To create a new layer, such as showing the economic globalization, you need to make a copy of your first layer and then change the attribute and choose the most appropriate symbols. Go on to the little blue dots, open the drop-down menu and then click on *Make a copy*. Do not forget to rename your new second layer with the name of the attribute you have chosen.
- 11 To save your map, click on the Save floppy disk icon and then select *Save as*. You need to give your map a *tag* so it can be saved. Click on the blue *Save as* button.



How to add map notes on an ArcGIS Online map

- 1 Once you are logged in on the ArcGIS Online homepage, click on the *New map* tab on the top left of the page. This will open a map window as in Figure 1.19.
- 2 You are going to learn how to add a map note to support a pattern shown by a layer. In this example, we will use a layer on global population change which will be enhanced by adding supportive evidence showing **population pyramids**, which are linked to population growth.
- 3 Click on the following link in order to add a map showing global population natural increase: <https://arcg.is/0f5qab>
- 4 Once you have added the map, the layer content panel should look as shown in Figure 1.37.



■ **Figure 1.37** Map with population growth layer

- 5 You are now going to add map notes on world regions or countries with contrasting levels of population growth over time. Think about areas with very high, medium and low rates of population change.

- 6 To add a map note, do the following:
 - a First you need to find population pyramid pictures of contrasting regions of the world in terms of population growth rates. You could look for pyramids for countries with less than 5 per cent growth rate, countries around 18 per cent and countries that have a population growth rate above 32 per cent, as shown in the *legend* (key) on your ArcGIS Online map. Use the internet for this or you could visit: www.populationpyramid.net/
 - b In this example, we searched for 'India population pyramid' to add to India on the map.
 - c On the Google image result page, click on a picture of the pyramid of your choice and then right click to copy the image web address (see Figure 1.38).



■ **Figure 1.38** Saving a source picture

- d The address is now saved in the 'clipboard' and you will paste it later.
- e Now add a small pop-up window to show your population pyramid picture. For this, go to *Add* and select *Map notes*.





- f On the left-hand side panel, you can either click a point (a pin) or draw an area (a polygon). Click on your chosen pin and click again on the country.

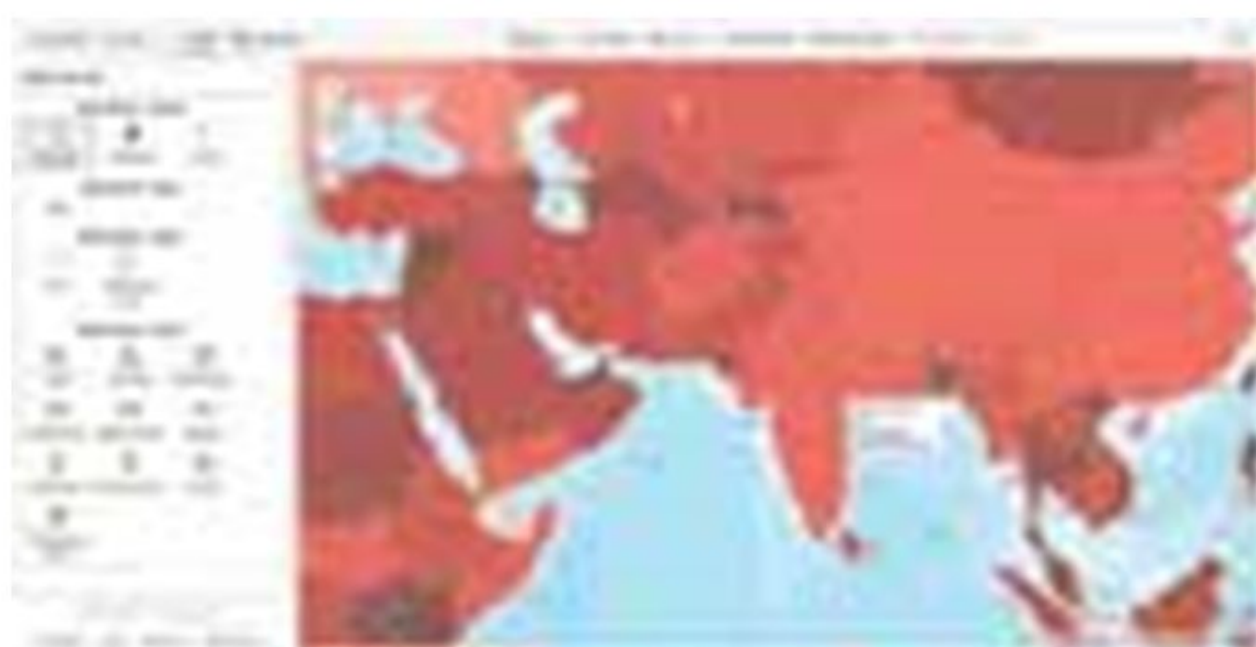
Add Map Notes

Name:

Thumbnail Map Notes:

Use Map Notes to create better displays of a wide variety of applications.

■ **Figure 1.39** Adding a map note



■ **Figure 1.40** Adding a map pin

Each symbol you draw will have a pop-up window that you must fill in with your own information and also the pyramid pictures.

Add the image web address you have copied to the clipboard (see Figure 1.41). This will add the picture to the pop-up window.



■ **Figure 1.41** Add the image web address into the map note dialogue box

Hint

Always check that you do not paste the *http://* prompt twice otherwise your picture will not be displayed.

- g Give your map note the name of the country you want to show on your map. This will make sorting through your map notes more easy.
- h In order to see your first fully completed pop-up, you must save your map, by clicking on Save and then Save as. Give your map a tag so it can be saved.



■ **Figure 1.42** Saving a map to see picture in pop-up

- i Repeat steps a to h for at least two more countries or regions.
- 7 In pairs, **compare and contrast** your ArcGIS Online maps. **To what extent** are the population pyramids supportive of the trend in contrasting population growth? Are some population pyramid shapes more closely linked to high growth rates than others? **Justify** your points with evidence from the maps.

How do geographers investigate diverse human and physical systems?

Geographers investigate places by asking questions about physical environments and the people that live in them. These questions are formulated in order for an inquiry to take place. Inquiry questions drive the geographical investigation, which involves collecting, presenting and evaluating the evidence before reaching a conclusion. Investigations may answer the inquiry question but in some cases they are inconclusive and a thorough evaluation of the methodology is often required. In this final activity in this chapter, we will apply the generic inquiry organizer (see Figure 1.44) to undertake an investigation.

DISCUSS



■ **Figure 1.43** Geographic Information System

To what extent do you think Figure 1.43 is a good illustration of the principles of GIS? **Discuss** with reference to the activities you complete in this chapter.

! Take action: Conducting an inquiry

■ ATL

- Information literacy skills: Collect and analyse data to identify solutions and make informed decisions
- Collaboration skills: Encourage others to contribute; Take responsibility for one's own actions

- ! In this final activity, you are going to conduct an inquiry at a small scale on a local issue. Your study area needs to be either near your home or near your school.
- ! Use the MYP concepts to design and **investigate** the impacts of human activity in a local area. You could **examine** the effects of different transport systems or waste management systems where you live. Consider the following:
 - ◆ the main modes of transport and associated infrastructure
 - ◆ noise pollution and traffic congestion
 - ◆ the provision for dealing with waste, such as bins and recycling collection points
 - ◆ the level of littering and waste pollution in public spaces.

- ! Brainstorm any particular interests, local knowledge or personal advantages in terms of accessing your primary and secondary data that could guide your investigation topic. This could be that you live near a city centre or a park, which would make completing the investigation manageable in terms of time and ease getting to your study area.
- ! **Discuss** your ideas with other students so you can **explore** possibilities to work as a group.

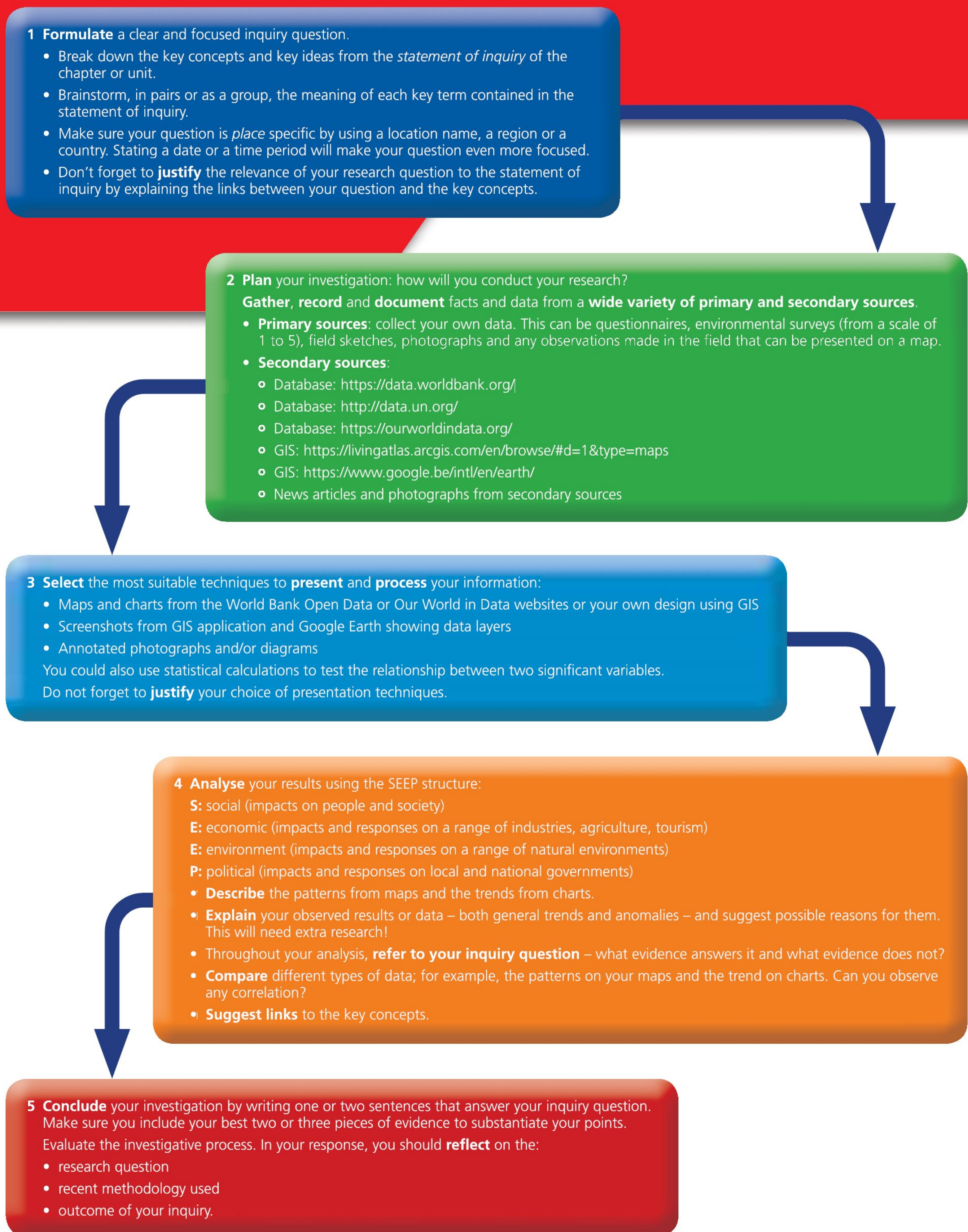
Hint

Use Figure 1.44 for help in structuring your investigation. The most important step is to get your inquiry question right. You will need to have it checked by your teacher before starting the data collection.

- ! **Present** your investigation in a format of your choice but don't forget that you need to include maps, some of which could be designed using GIS.

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion B: Investigating, Criterion C: Communicating and Criterion D: Thinking critically



■ **Figure 1.44** Generic inquiry organizer

Reflection

In this chapter, we have **found** out the different skills and techniques used by geographers to investigate human and physical systems. We have **explored** how geography is helping to understand changes over time and space. We have **taken action** by carrying out a geographical inquiry.

Use this table to reflect on your own learning in this chapter.					
Questions we asked	Answers we found	Any further questions now?			
Factual: What is the geographer’s craft? How do geographers look at the world? How do geographers analyse trends? How do geographers investigate diverse human and physical systems?					
Conceptual: How does geography help us understand changes in time and space? How do geographers think?					
Debatable: What makes geography important now?					
Approaches to learning you used in this chapter:	Description – what new skills did you learn?	How well did you master the skills?			
		Novice	Learner	Practitioner	Expert
Collaboration skills					
Creative-thinking skills					
Critical-thinking skills					
Information literacy skills					
Transfer skills					
Learner profile attribute(s)	Reflect on the importance of being a good inquirer for your learning in this chapter.				
Inquirer					

2

How many are we? How many should we be?



- Population and migration trends change in time and in place, and it is important that interventions to manage them respect the societies and individuals involved.

CONSIDER THESE QUESTIONS:

Factual: Where are all the people? How do we measure population growth?

Conceptual: How do we represent population trends and patterns? What processes are driving trends and patterns of population growth? Why is it difficult to manage population? How does migration affect population?

Debatable: What rights and responsibilities must be considered for future populations?

Now **share and compare** your thoughts and ideas with your partner, or with the whole class.



■ **Figure 2.1** People around the world

IN THIS CHAPTER, WE WILL ...

- **Find out** how population is measured and how population and migration have changed over time.
- **Explore** population issues and how governments have tried to manage these issues.
- **Take action** by raising awareness about population and poverty and the plight of refugees around the world, and the rights and responsibilities of individuals and societies when managing population and migration.

■ These Approaches to Learning (ATL) skills will be useful ...

- Collaboration skills
- Communication skills
- Critical-thinking skills
- Information literacy skills

● We will reflect on this learner profile attribute ...

- Inquirer – we will inquire into contemporary issues regarding population, such as population growth, population policies and issues of migration.

◆ Assessment opportunities in this chapter:

- ◆ Criterion A: Knowing and understanding
- ◆ Criterion B: Investigating
- ◆ Criterion C: Communicating
- ◆ Criterion D: Thinking critically

KEY WORDS

dense
population density
distribution
sparse

CONNECT–EXTEND–CHALLENGE

Read this excerpt from an article from *National Geographic* magazine:

Population debates like this are why, in 2011, National Geographic published a series called '7 Billion' on world population, its trends, implications, and future. After years of examining global environmental issues such as climate change, energy, food supply, and freshwater, we thought the time was ripe for a deep discussion of people and how we are connected to all these other issues – issues that are getting increased attention today, amid the new population projections.

After all, how many of us there are, how many children we have, how long we live, and where and how we live affect virtually every aspect of the planet upon which we rely to survive: the land, oceans, fisheries, forests, wildlife, grasslands, rivers and lakes, groundwater, air quality, atmosphere, weather, and climate.

World population passed 7 billion on October 31, 2011, according to the United Nations. Just who the 7 billionth person was and where he or she was born remain a mystery; there is no actual cadre of census takers who go house to house in every country, counting people. Instead, population estimates are made by most national governments and international organizations such as the UN. These estimates are based on assumptions about existing population size and expectations of fertility, mortality, and migration in a geographic area.

From: National Geographic online article, Dennis Dimick, 21 September 2014

Look at the three questions below and make notes on each. You will be going back to this Visible Thinking Routine at the end of the chapter to review the material and to find out what further questions you might have.

Connect: How are the ideas and information presented in this article connected to what you already know?

Extend: What new ideas and information have you found that have extended or pushed your thinking in new directions?

Challenge: What is still challenging or confusing for you to get your mind around? What questions, wonders or puzzles do you have now?

In this chapter, we will be exploring population patterns and how change has occurred over time and place. Population study is one of the foundation topics for geography. We need to understand why populations have grown over the last 200 years, and what impacts this population growth has had on our planet. In order to try and plan for our future we need to consider who has the right and the responsibility for controlling the population, whether through birth control or migration.

Where are all the people?

THINK–PAIR–SHARE

On your own, make a **list** of the natural resources and physical features you need to survive. Looking at this list of survival needs, can you think of places around the world where you could not live? Make **list** of some of these places and think about any physical features they have in common. Share this list of features with a partner and then as a class. Do you have any features in common?

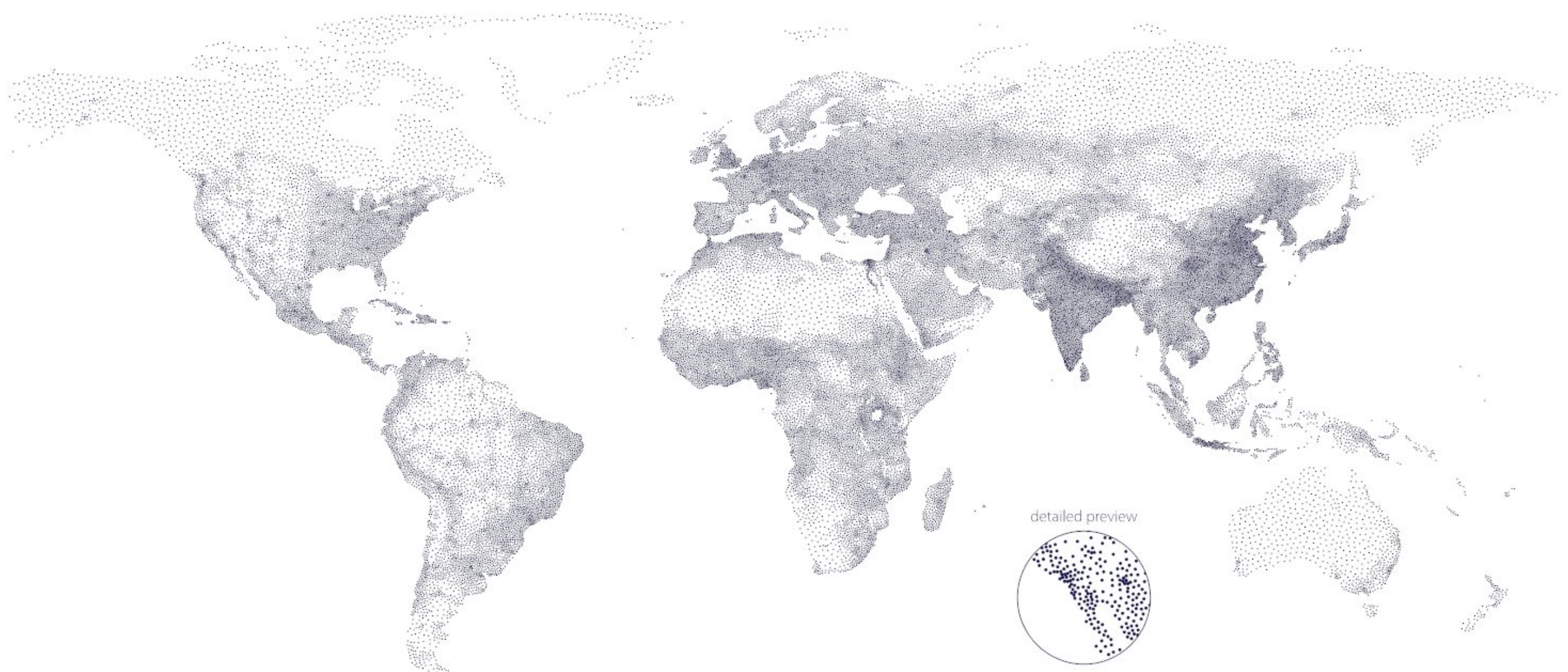
The issues surrounding population are very complex, while the impacts of population growth on the future for our species is one of the most significant issues for humanity. Are we overpopulated? Do we need radical solutions to stop the increase in population? Why might we need to slow global population growth? Or, is more always better? To start, we need to know where people live and why they live in these areas.

Many places around the world have very few inhabitants. These places may have extreme climates or poor soil, be too mountainous, or be too remote. Just one-third of the Earth's surface is land and, of that, just one-third is inhabited by more than 20 people per square kilometre.

Figure 2.2 shows a dot map of the world's population density. The deeper the colour (more dots), the more people live there per square kilometre. Areas with darker colours are densely populated, while the light areas, where few people live, are sparsely populated.

Refer back to the Visible Thinking Routine at the top of this page. Did the places you suggested correspond to the areas that you can now see have a very low population density? Both human and physical factors affect where people live. Physical factors are the **relief** of the land, soil quality, climate type, vegetation type, physical accessibility and fresh water supply. Human factors can be economic, political and technological.

Global Population Density



■ **Figure 2.2** A dot map of the world population density

ACTIVITY: The human factor

■ ATL

- Information literacy skills: Access information to be informed and inform others

Make a copy of Table 2.1 and then write each factor from the box in the correct column, according to whether it is a factor causing dense or sparse population. For each one, add an example of a place or region.

Flat land Many ports/access to markets
Low or high temperature Lack of investment in area
Little government investment Poor soils
Little technology used to increase water supply
Very mountainous
Little access to markets Temperate forest
Reliable rainfall all year Temperate climate
Investment in region by government
Rich, fertile soil Investment in area
Rich rainforest Technologies such as irrigation used
Lack of sufficient rainfall

Factors: Human or physical	Densely populated areas	Sparsely populated areas
Technological		
Economic		
Political		
Physical accessibility		
Climate		
Water supply		
Relief		
Soils		
Vegetation		

■ **Table 2.1** Factors causing dense and sparse population

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding.

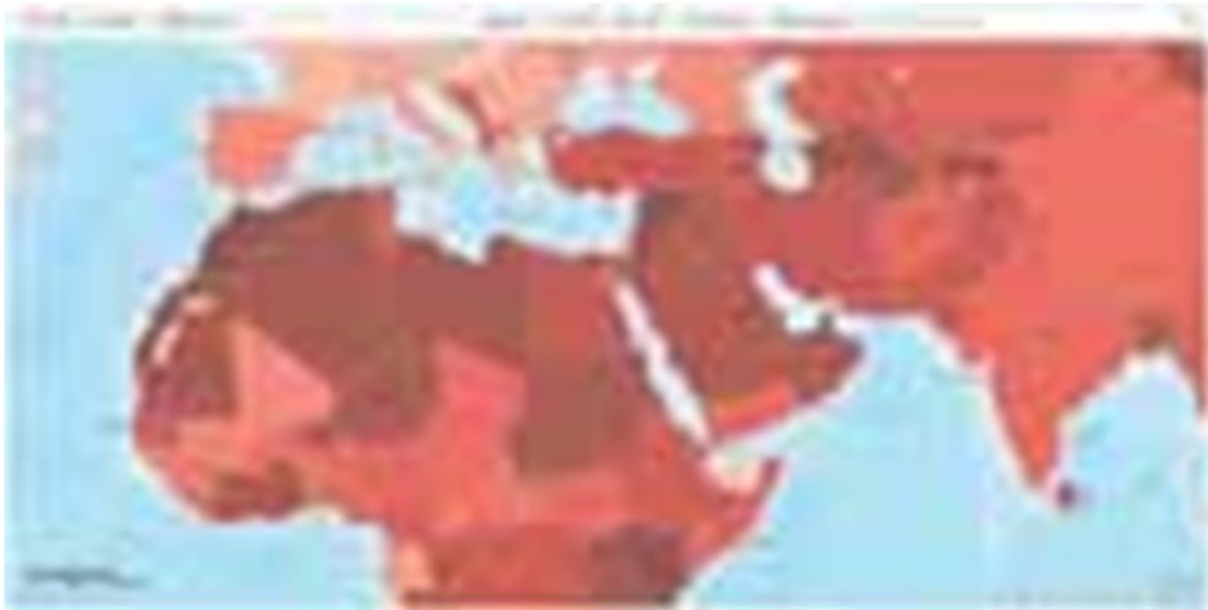
As the world’s population has grown, many areas have seen an increase in population growth, and therefore the pattern of population density has changed over time. To see this change, we need to look at how the population has increased and in what areas.

ACTIVITY: What is the global pattern in population growth?

■ ATL

- Information literacy skills: Understand and use technology systems

- 1 Log in to an ArcGIS Online account, and click on the *New map* tab on the top left of the page. This will open a map window.
- 2 Click on this link in order to add a map layer showing global population increase: <https://arcg.is/0f5qab>.
- 3 Once you have added the layer, the map should look like this:



■ **Figure 2.3** World population change

- 4 In pairs, discuss the world pattern of population growth. Use the TEA structure (see page 12). How can you explain the distribution pattern?

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding.

How do we measure population growth?

To gather information on the population we need to look at certain factors that can affect population growth such as **crude birth rate** and **crude death rate**. The birth rate is the number of live births per 1,000 people in a given area per year; death rate is the total deaths per 1,000 people in a given area per year. To establish the population trend of a region or country, its natural increase (or in some cases decrease), we need to look at the difference between the crude birth rate and crude death rate. However, population growth or natural increase is not just affected by the number of births or deaths in a place, but also by who is moving in (**immigrating**) or out (**emigrating**).

In many regions, the population is growing due to an increase in births and a decrease in the number of deaths. As technology has improved health care over time, more and more people are living for longer. To measure this, we look at **life expectancy**; this is the average number of years a person in a particular region is expected to live, at the time of birth. The world's life expectancy in 2017 was 71 years, whereas in 1969 it was 52. Another reason for total population change is **fertility rate**, which is defined as the average number of children a woman gives birth to in her lifetime. This is calculated by taking the total number of births and dividing it by all the women in the fertile age range (15–55 years). Other important measurements are **infant mortality rate** and **child mortality rate**. Infant mortality rate measures the number of infants who die before the age of one, and the child mortality rate is the number of children under the age of five who die.

Most countries collect data through government census, or via hospitals, health clinics and other official groups. However, not all countries have access to these and the cost of collecting the data can be high. Also, not all countries collect the data in the same way, which means that we cannot be sure the data from every country accurately

reflect its population. Moreover, data can give us the patterns and trends, but do not give the causes or whether there is a high ratio of children dying in certain regions. To get a complete and detailed picture we need to consider other factors, such as disease prevalence or the country's income.

ACTIVITY: Population factors

- ATL
- Critical-thinking skills: Draw reasonable conclusions and generalizations

Define the following:

- Crude birth rate
- Crude death rate
- Natural increase
- Natural decrease
- Fertility rate
- Immigration
- Emigration
- Child mortality
- Infant mortality
- Life expectancy

Copy and complete Table 2.2 to **evaluate** the following population factors that are used in the measurement of population growth.

Population factors	Advantages	Disadvantages
Crude birth rate		
Crude death rate		
Fertility rate		
Child mortality		

■ **Table 2.2** Population factors

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.

How do we represent population trends and patterns?

Population data can reveal trends and patterns, such as how the population has changed over time and how the population compares to that in other countries or regions.

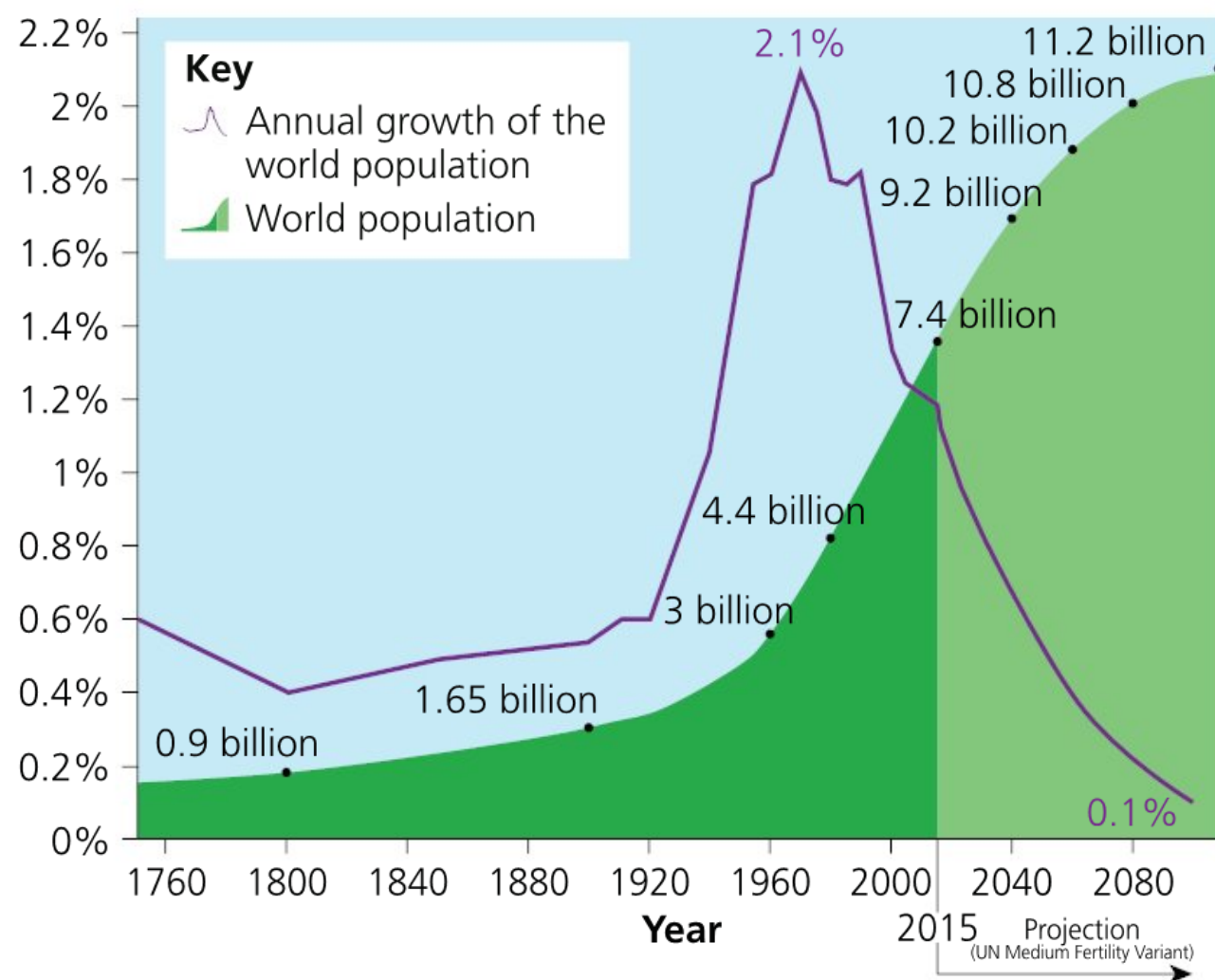


Figure 2.4 Line graph showing the world population and annual growth rate, 1750–2100

Figure 2.4 shows the world population total since 1750. Since 1960 the annual growth rate of the world population has fallen. However, at the same time, the total population has continued to increase. **Doubling time** (the time it takes the world's population to double) shows how quickly a population is growing. Why does the world population still grow, even though the annual growth rate has declined?

You will notice (see Figure 2.4) that the highest annual growth of the world population occurred between 1950 and 1990, peaking at 2.1% around 1970. This 'bump' of people will grow up and reach the age where they may have children over the subsequent decades and so will produce more offspring. More people giving birth means more babies being born to more people, rather than a higher global fertility rate (more babies being born to the same number of women).

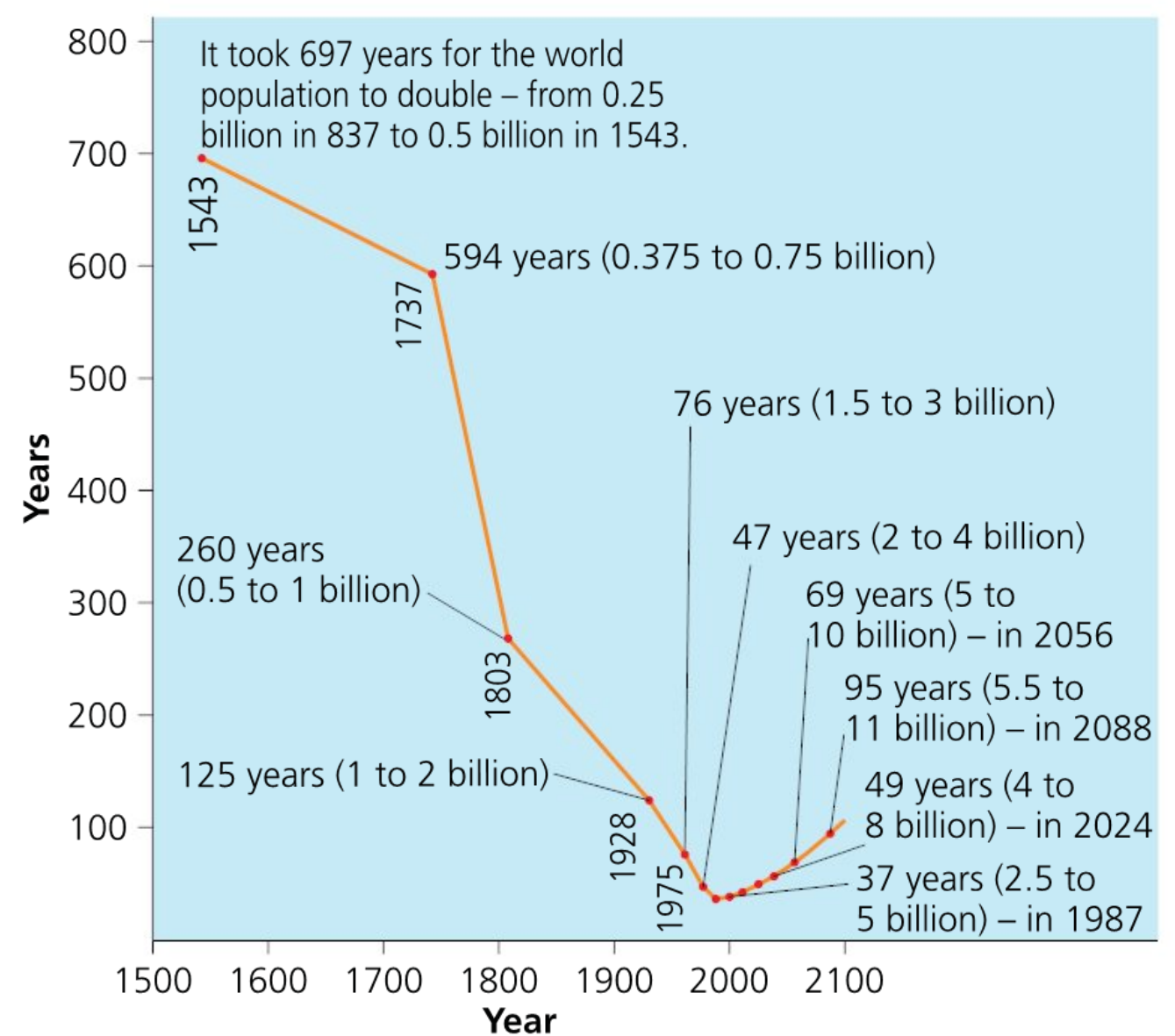


Figure 2.5 The time it took the world's population to double (historical estimates until 2015, UN projections until 2100). From 1803 to 1928, the population doubled in 125 years. However, to double again (in 1975) took only 76 years.

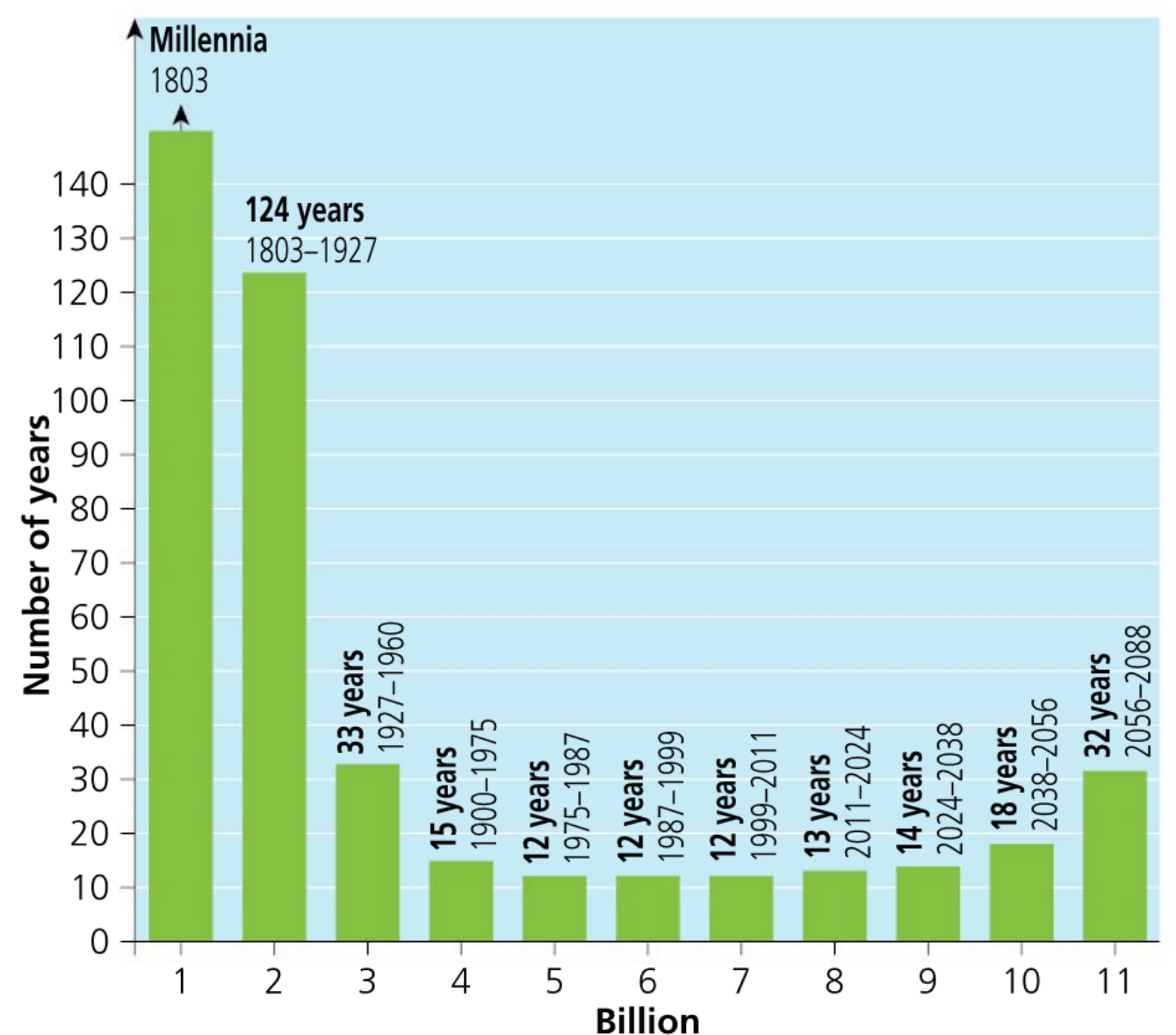
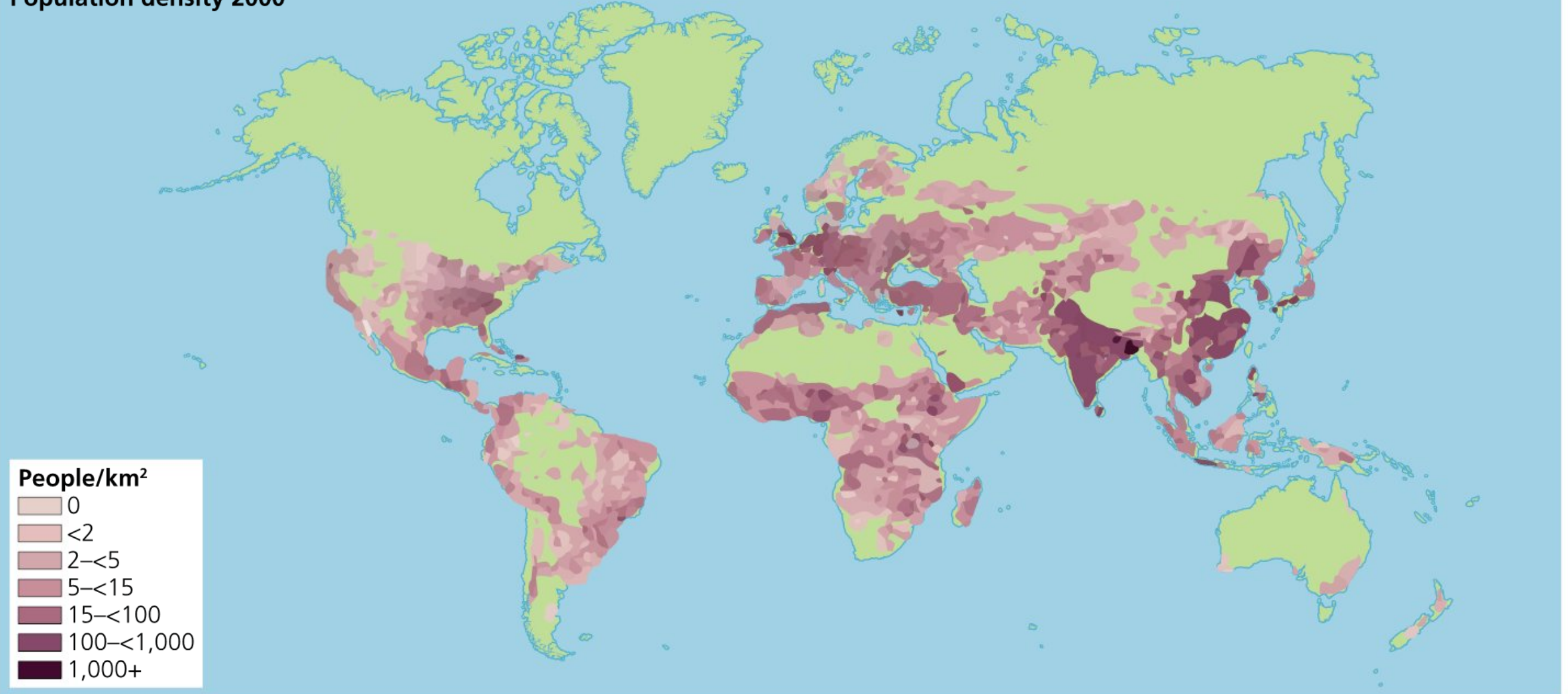
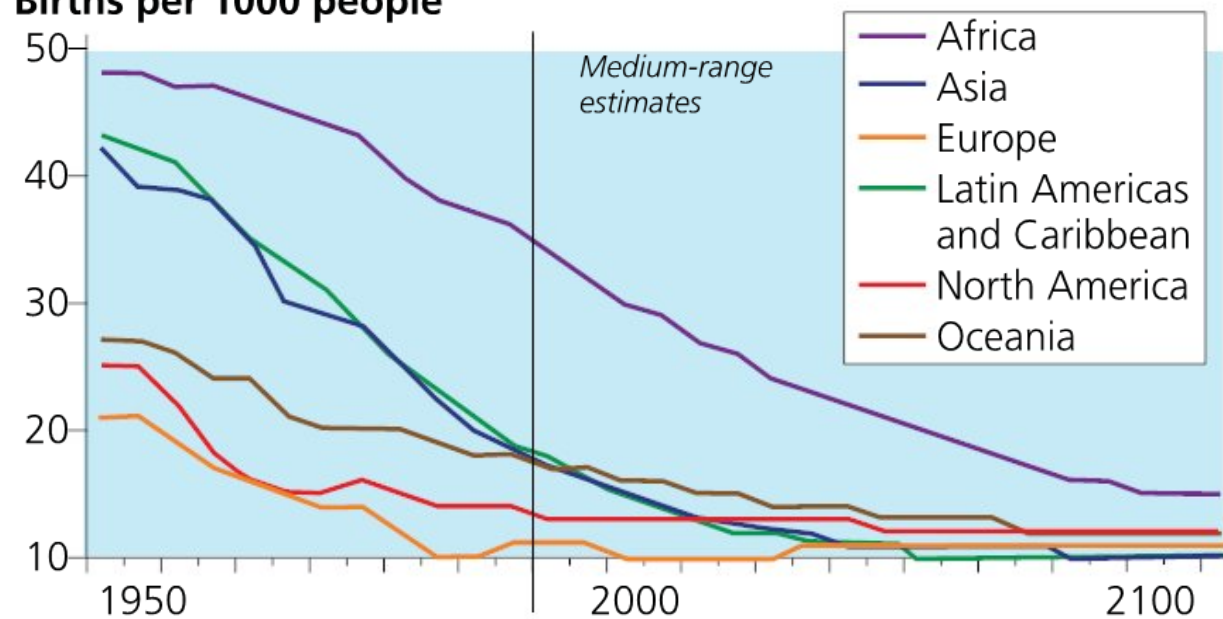


Figure 2.6 The time it took the global population to increase by 1 billion

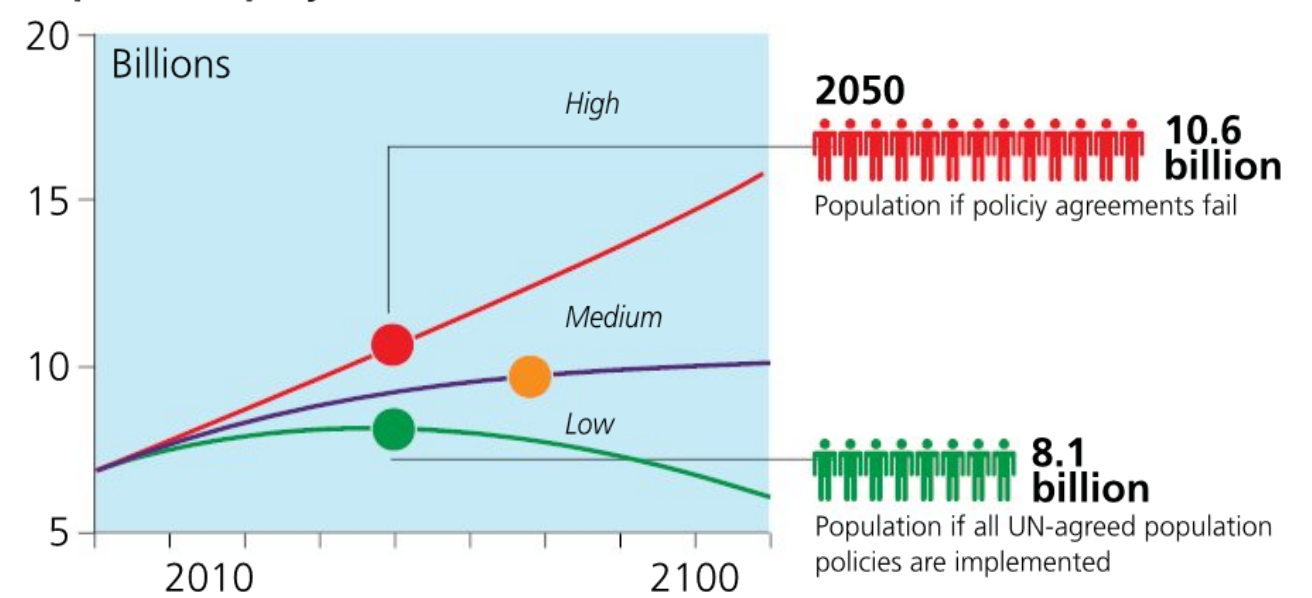
Population density 2000



Fertility rates Births per 1000 people

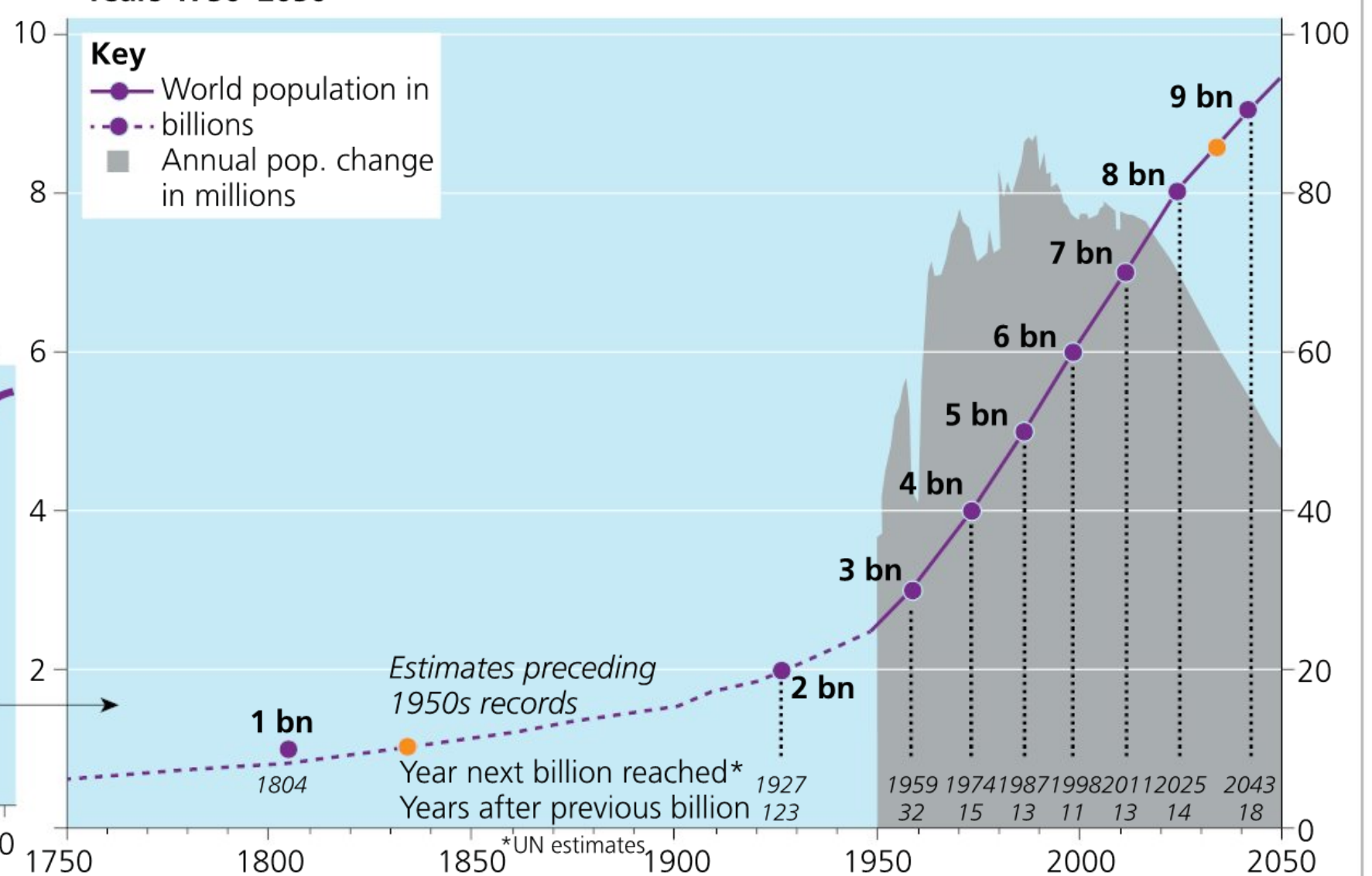


Population projections



It took less than a century to reach the next billion people after reaching the first billion in 1803. Since 1960, the world population has more than doubled. With recent figures putting the annual number of people added to the world population at 80 million per year, the world adds the numerical equivalent of another USA to its population every four years.

Years 1750–2050



World population in billions Years 0–2150

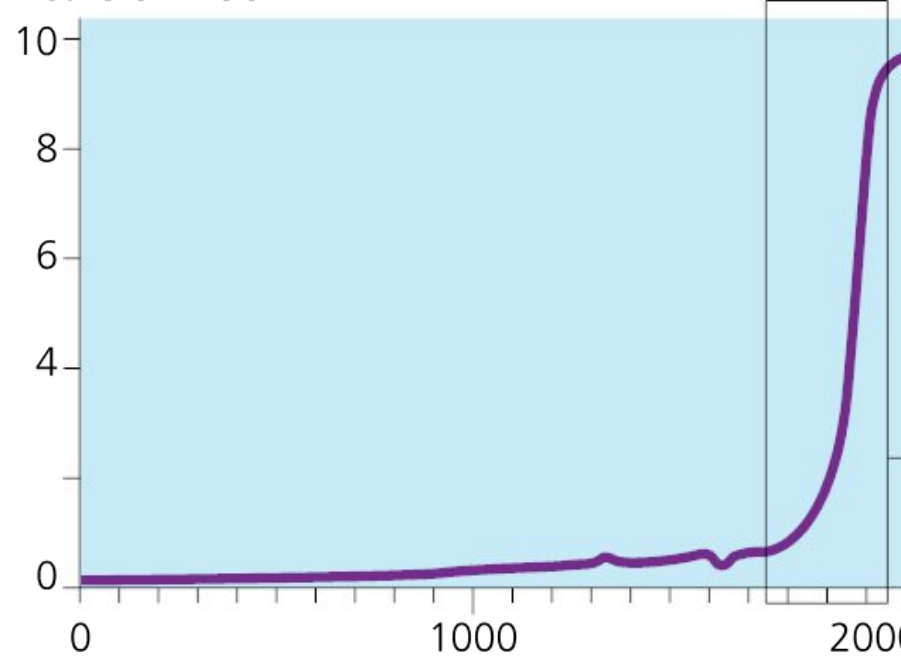


Figure 2.7 An infographic for the world's growing population

ACTIVITY: Reading trends and patterns

■ ATL

■ Critical-thinking skills: Interpret data

Study Figures 2.4, 2.5 and 2.6.

- 1 **Describe** the information provided by Figure 2.5.
- 2 **Analyse** Figure 2.4 and Figure 2.5.
- 3 **Identify** the period during which the annual growth rate is over 1.5 per cent.
- 4 **Identify** the period during which the population grows by 1 billion in 15 years or less.
- 5 With reference to Figure 2.4, **explain** why the world population is still growing, even though the annual growth rate has declined.

Now **analyse** Figure 2.7 to find the information to answer the following questions:

- 6 **Describe** the trend in the fertility rate in Africa since 1950.
- 7 **State** how many years it took the world population to grow from 1 billion to 6 billion.
- 8 **State** the highest and lowest population projection for 2050, according to the UN.
- 9 **Evaluate** how useful the infographic is to show the world's growing population. (Remember to refer to value and limitations.)

◆ Assessment opportunities

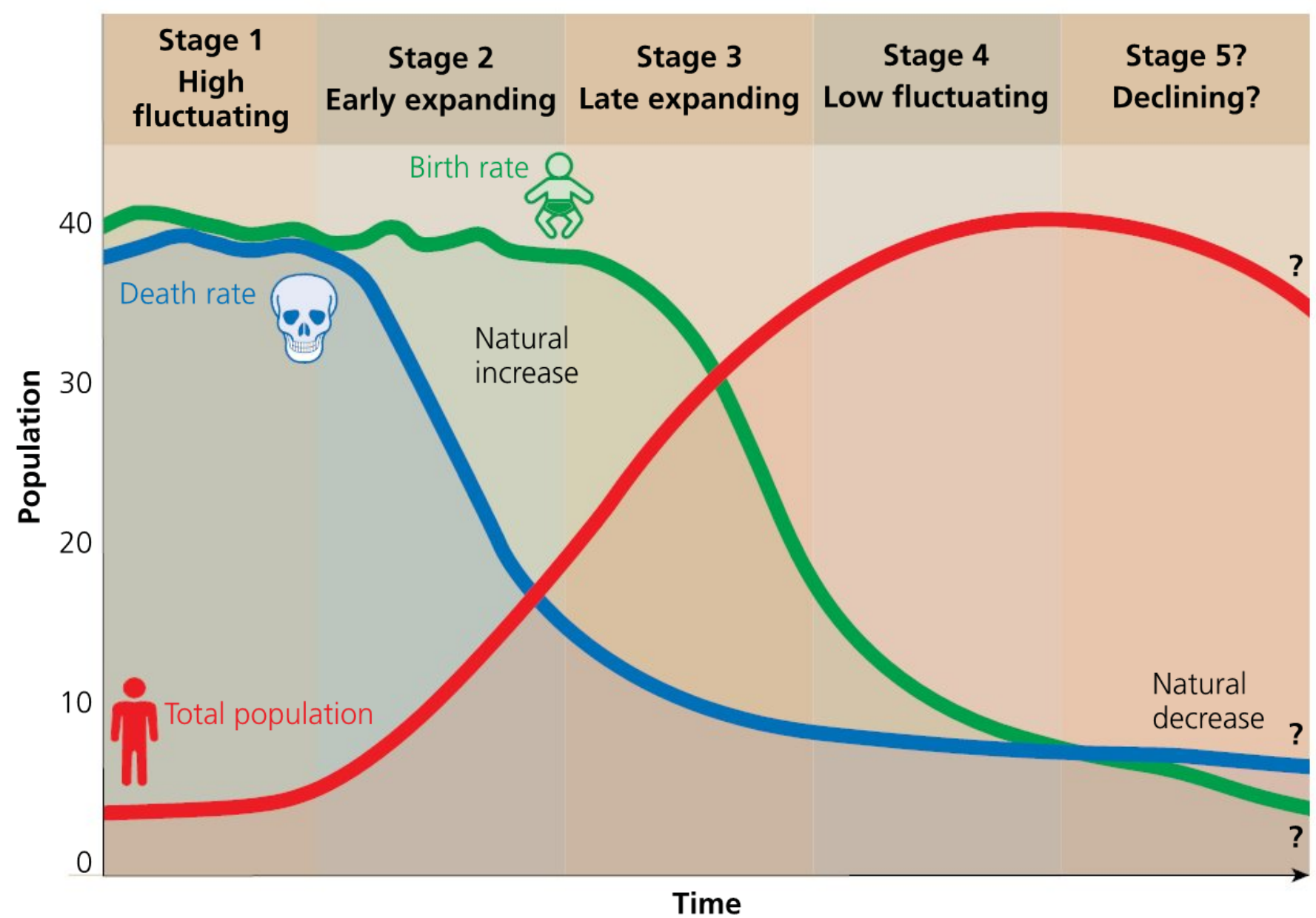
- ◆ In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding and Criterion D: Thinking critically.

What processes are driving trends and patterns of population growth?

All the trends in population data show rapid growth from the beginning of the nineteenth century to extremely rapid growth by the start of the twentieth century. What were the processes that drove this increase in the global population? What were, and are, the consequences of this global population growth, and what can we do to address these consequences?

The Demographic Transition Model (DTM) in Figure 2.8 shows how the birth rate and death rate can affect total population growth. This model can be used to show a trend over time for a particular country and the pattern for the present day.

If we analyse the model, we see that in stage 1 there is a high birth rate, but also a high death rate; therefore the total population is stable. In stage 2, the birth rate is still high, but the death rate starts to fall, which means the total population starts to increase. Stage 3 is when the birth rate starts to decrease, but the total population is still increasing. Stage 4 is when there is a low birth rate and low death rate, but as the population increases over time, the total population is high. Stage 5 is when the total population starts to decline as the death rate is higher than the birth rate. Note that the model was developed in Europe and focuses only on birth and death rates, and not migration. You can find out more about the history behind global population change in *MYP Individuals & Societies by Concept 3*, pages 84–5 and page 94.



■ **Figure 2.8** The Demographic Transition Model

Figure 2.9 shows an annotated Demographic Transition Model for the UK. Although these data are particular for the UK, the reasons for the demographic trends may be similar to those for many other countries across the globe. Historically, disease and the lack of medicine during many centuries meant that the death rate and child mortality rate were high. Therefore, people tended to have larger families as they knew a number of their children would not survive into adulthood. Other factors affecting the higher death rate are war and conflict, natural disasters and famine and drought. However, better, clean housing, access to clean water, access to a variety of healthy foods, contraception, an increased understanding of issues such as cleanliness and disease, women having access to education and going out to work, more access to doctors and nurses, and better hospitals all are reasons why the population has changed.

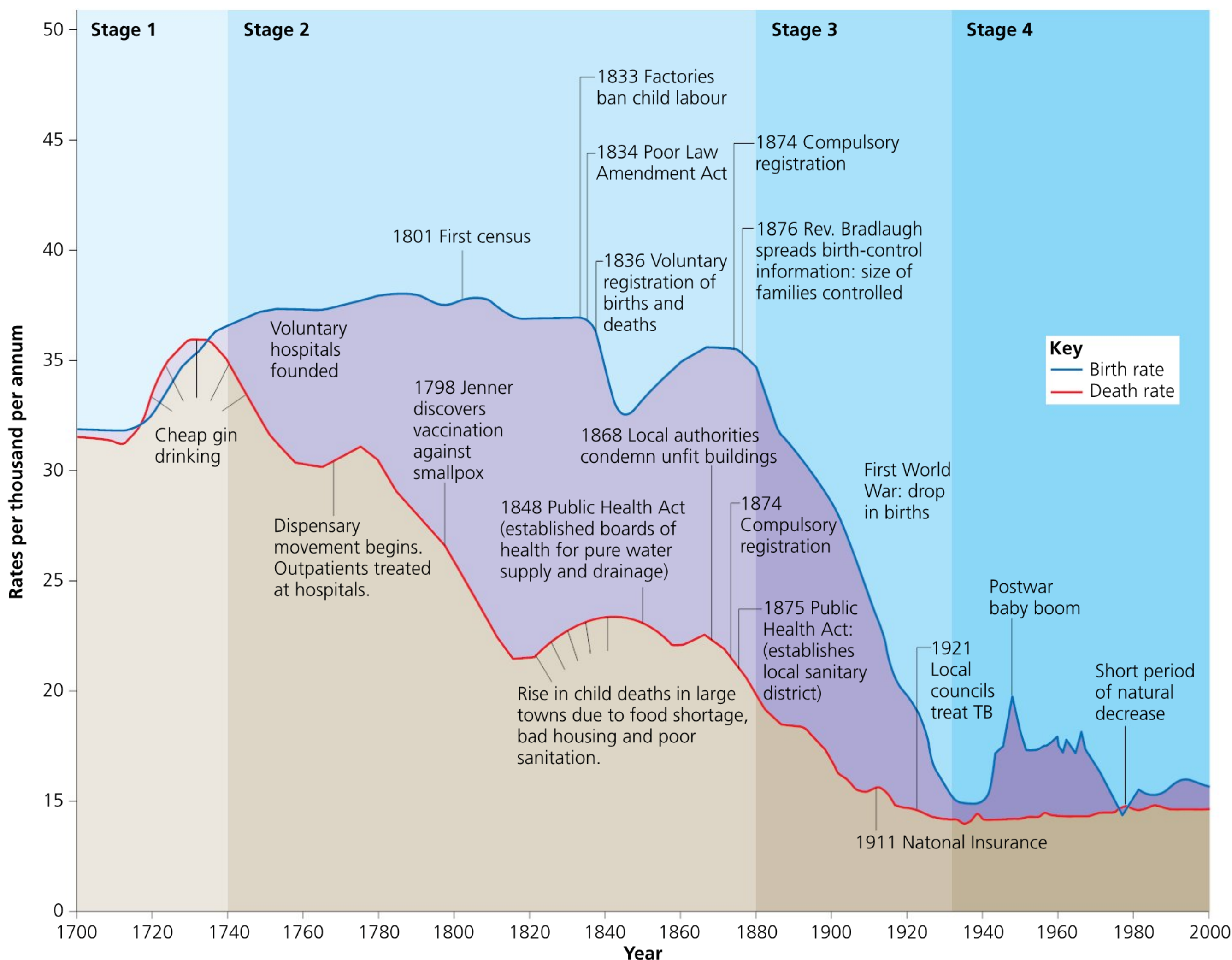


Figure 2.9 An annotated Demographic Transition Model for the UK

ACTIVITY: What's in a model?

■ ATL

- Critical-thinking skills: Interpret data
- Information literacy skills: Make connections between various sources of information

Study Germany and Mauritius in Figure 2.10.

State in what years both Germany and Mauritius fall into stages 1, 2, 3, 4 and 5 of the DTM.

Identify any anomalies that both Germany and Mauritius have in their DTM.

Investigate countries or areas that are in stages 1, 2, 3, 4 and 5 and copy and complete Table 2.3. Use the following website to help you: <https://populationeducation.org/what-demographic-transition-model/>

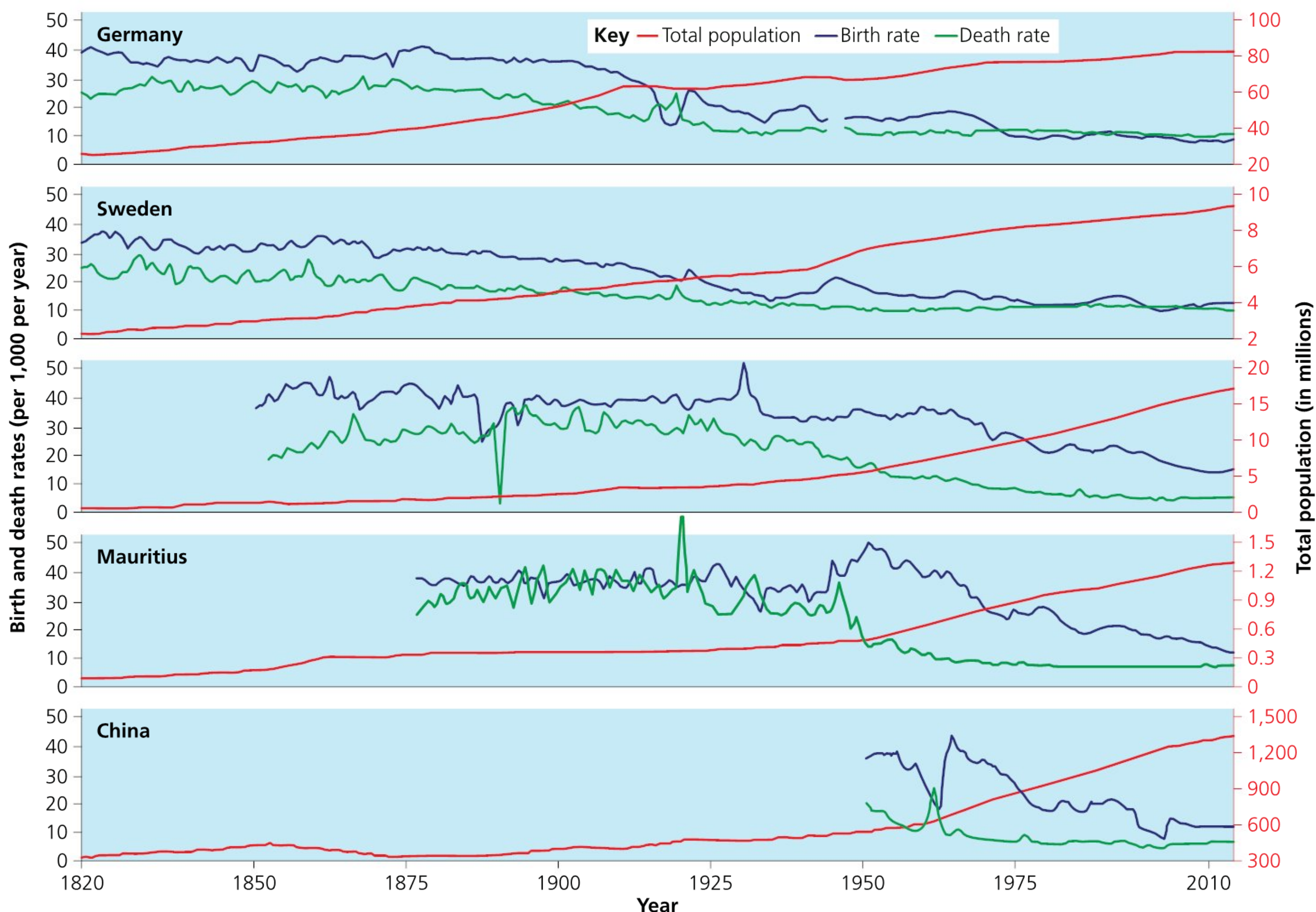
Country name	Stage of DTM	Evidence for stage	Reasons why the country is at this stage
	1 High fluctuating		
	2 Early expanding		
	3 Late expanding		
	4 Low fluctuating		
	5 Decline		

■ **Table 2.3** Stages of the Demographic Transition Model

How useful is the DTM in helping us to understand population trends and patterns?

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding and Criterion B: Investigating.



■ **Figure 2.10** Demographic Transition Models for five countries

POPULATION STRUCTURE

You have seen how a model is used to show how trends and patterns of birth and death rates can affect the total population. However, the Demographic Transition Model does not show the percentage of females and males in the country, the ages of the population or the population structure. These details are shown on an age-sex pyramid, or population pyramid.

ACTIVITY: Building population pyramids

■ ATL

■ Critical-thinking skills: Draw reasonable conclusions and generalizations

Analyse the population pyramid in Figure 2.11 to answer the following questions:

1

What is the total number of males aged 0–4?

2

What is the total number of females aged 45–49?

3

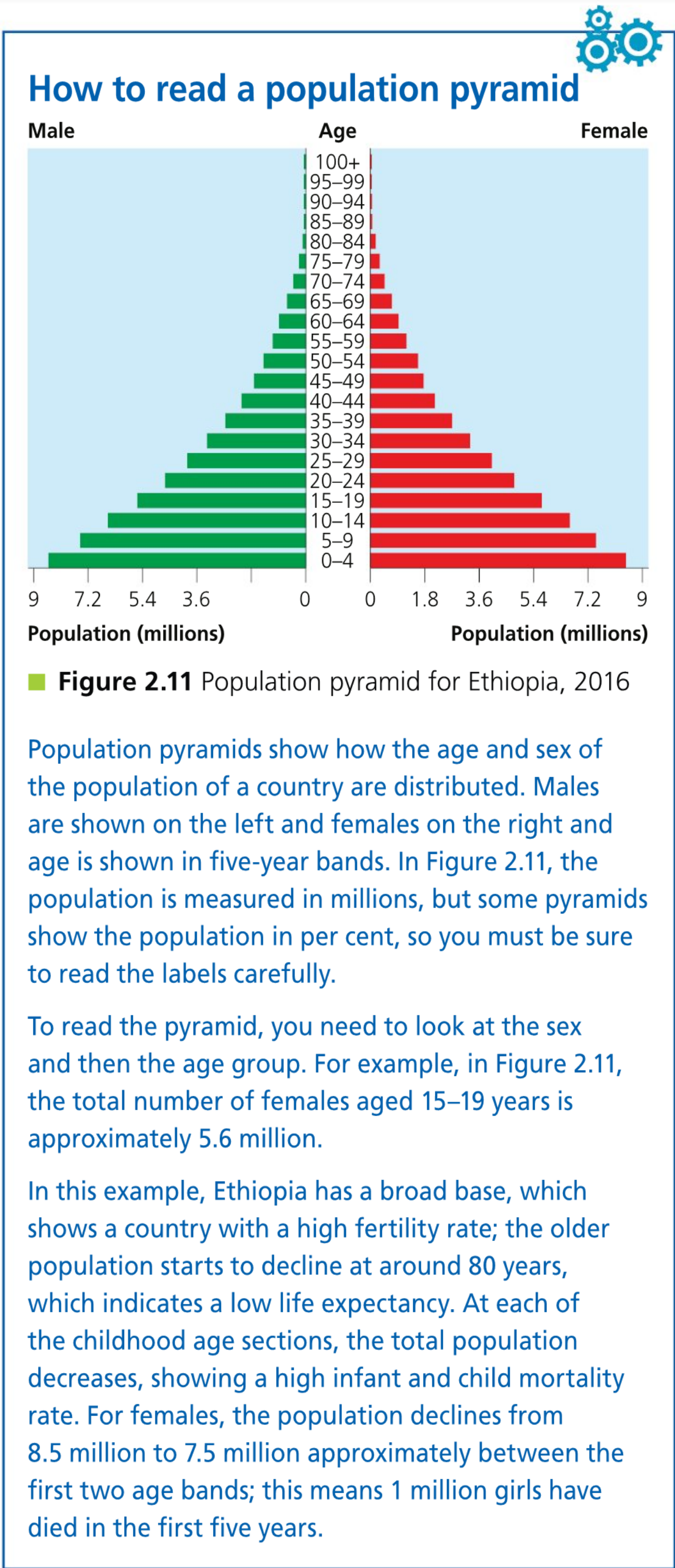
What is the total number of males and females aged 5–9?

4

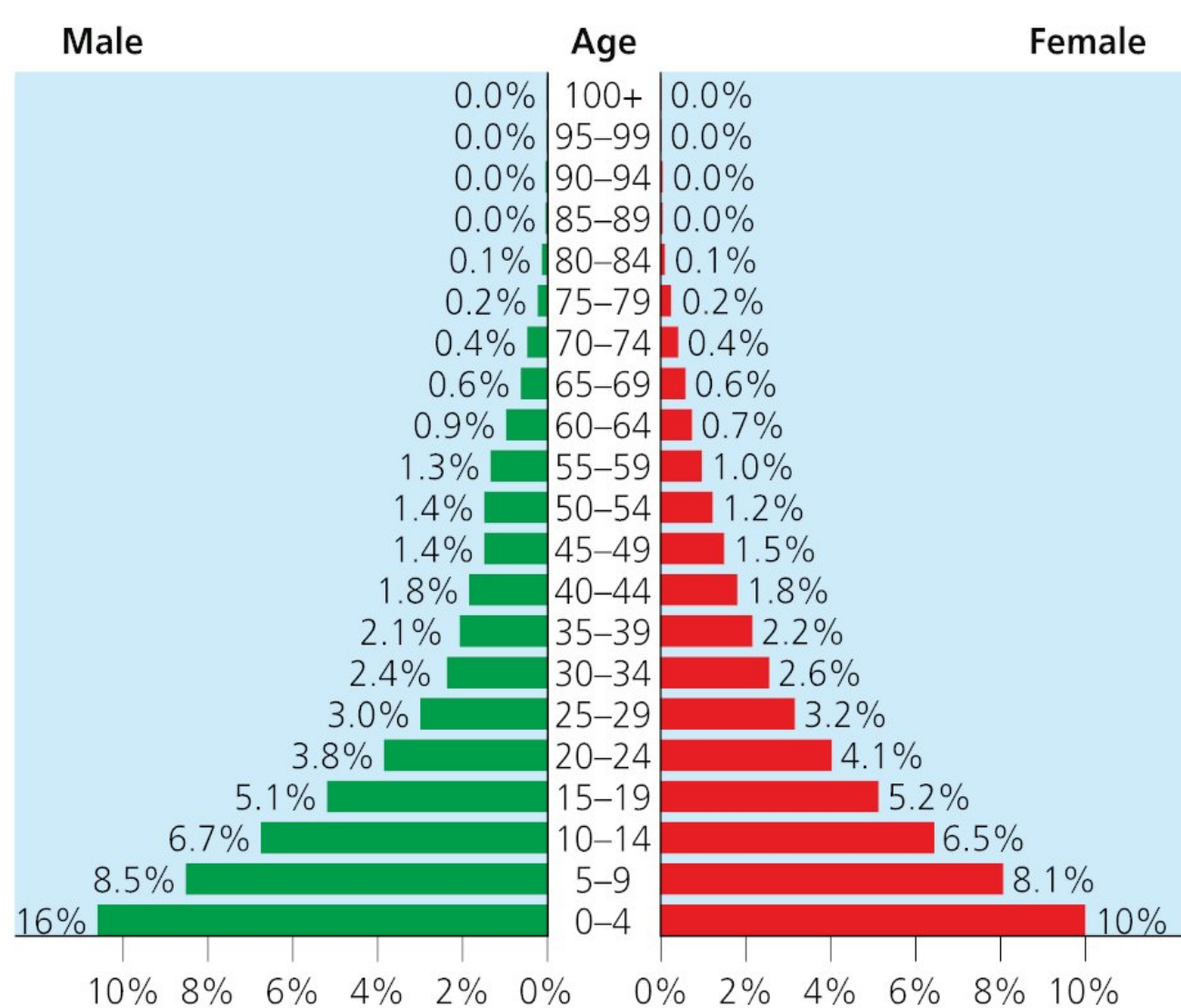
What do you think will happen to the population in Ethiopia in the next 50 years, if the birth rate decreases and life expectancy increases?

◆ Assessment opportunities

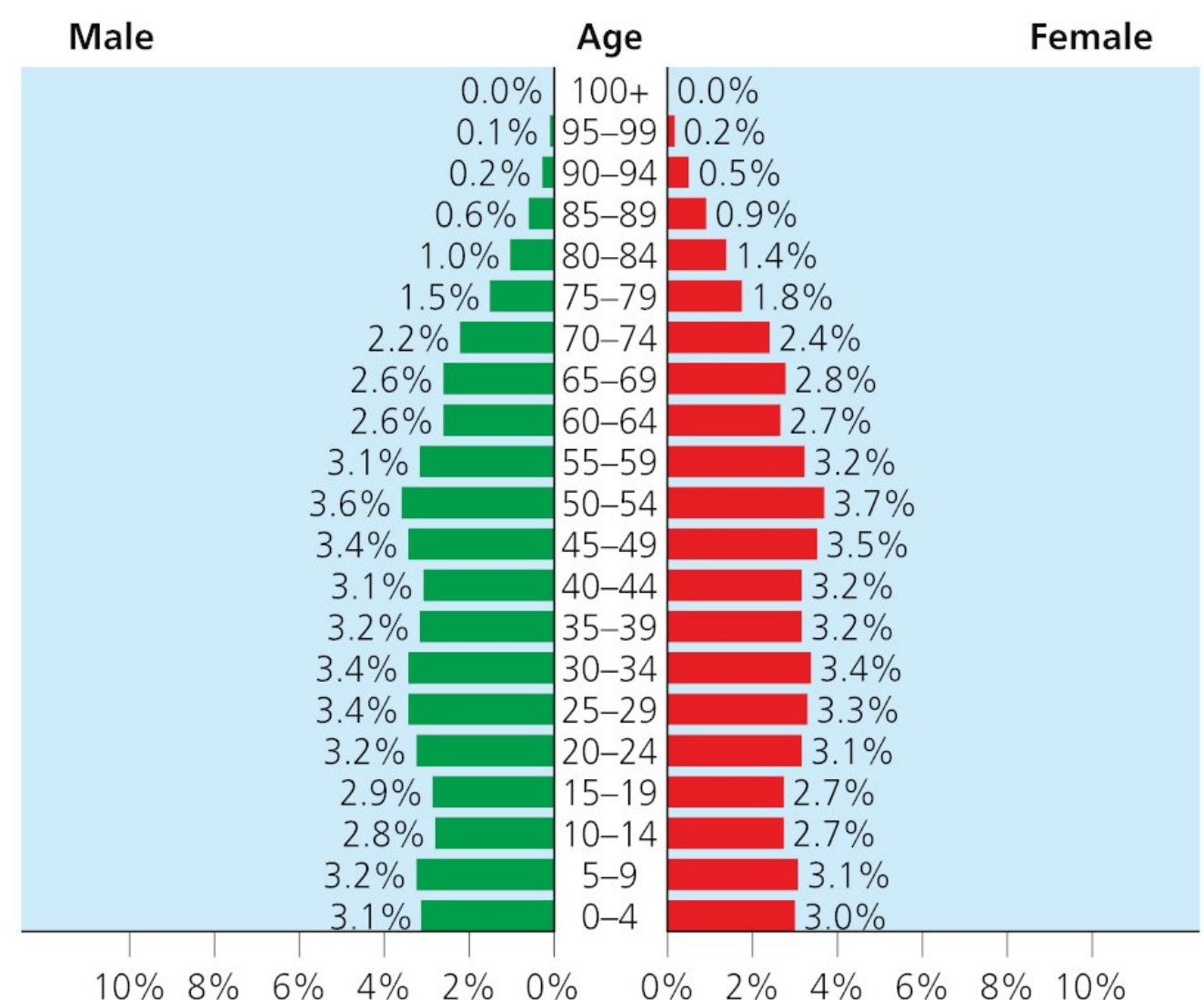
◆ In this activity you have practised skills that are assessed using Criterion D: Thinking critically.



Population pyramids are important when looking at **demography** because they provide an easy way to compare differences in age and sex. They are also useful when comparing countries. They show the trend within a country and patterns between different countries. We can also see how many young children and elderly people there are in the country, which is particularly useful to enable population policymakers to see how many people in a country depend on those of working age and what is going to happen in the future.



■ **Figure 2.12** Population pyramid for Niger, 2017



■ **Figure 2.13** Population pyramid for the UK, 2017

Figures 2.12 and 2.13 show two very different population pyramids for the same year, 2017. By studying these pyramids, we can discern the factors that are affecting population in these countries. For example, **compare** Niger's population of 0–4 years for female and male. Usually, the number of female and male is almost the same; about 0.1 per cent more boys are born in most places. However, in this country we can see that the number of boys born exceeds girls by 6 per cent, which is very high. What has happened here? One suggestion is that there is a cultural preference for boys, and therefore more girls are being aborted. There is also a low life expectancy, since very few people live beyond 80 years, while there is a high fertility rate, as indicated by the broad base. There is a high child mortality rate, which we can see by the difference between the 0–4 years and 5–9 years age bands; females have dropped from 10 per cent to 8.1 per cent, and males have dropped from 16 per cent to 8.5 per cent.

DISCUSS

What might be the reasons for a high infant mortality rate, low life expectancy and a high fertility rate? What are the factors in the UK that make its population structure very different from that of Niger?

ACTIVITY: Comparing population structures

■ ATL

- Communication skills: Make inferences and draw conclusions
- Critical-thinking skills: Identify trends and forecast possibilities

Using your own knowledge and the websites below, carry out further research into the demographics in the UK and Niger:

- www.cia.gov/library/publications/the-world-factbook/geos/uk.html
- www.cia.gov/library/publications/the-world-factbook/geos/ng.html

Explain the processes and factors that determine the population structure in Niger and the UK. Copy and complete Table 2.4 to help you **organize** your findings and ideas.

Geographical factors	Niger	UK
Social/cultural		
Economic		
Environmental		
Political		

■ **Table 2.4** Population structures in Niger and the UK

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding and Criterion D: Thinking critically.

▼ Links to: History

The history of health care and the development of medicine are very important when considering demographics. What links health to the growth or decline of population indicators such as infant mortality rate, death rate, etc.? How does the development of medicine affect changes in the population over time?

! Take action: Population matters

■ ATL

- Information literacy skills: Access information to be informed and inform others

- ! Carry out an investigation to **identify** countries that still have high infant mortality rates and high rates of maternal death (mothers dying during pregnancy, or while giving birth).
 - ◆ What are the issues that lead to these factors?
 - ◆ What are charities and other non-governmental organizations doing to address these issues?
- ! Prepare a class **presentation** to raise awareness about these issues, and what might be done to address them.
- ! Here are some examples of charities that have a focus on infant and maternal deaths:
 - ◆ www.careinternational.org.uk/fighting-poverty/improving-health/maternal-health
 - ◆ www.gatesfoundation.org/What-We-Do/Global-Development/Maternal-Newborn-and-Child-Health

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion B: Investigating and Criterion C: Communicating.

Why is it difficult to manage population?

We have seen from our analysis of the population pyramids for Niger and the UK some of the reasons for their population structure for 2017. However, what are the issues for the future of these population structures? Policymakers need to know how to plan for the future, where to invest and from where they will obtain the money.

Populations are divided into three sections: the youthful age group is 0–15 years of age, the elderly, ageing population is over 60 years, and the working age group is 15–59 years. When there are too many young people or old people compared to the working population, then it is said that a country has either a youthful population or an ageing population.

Niger has a higher proportion of its population under the age of 15 than the UK: according to the CIA *World Factbook*, in 2017 the figure in Niger was 49 per cent, therefore Niger has a youthful population; in the UK the figure was 17.6%. The government and policymakers will need to know how to invest for the future, bearing in mind what will happen when these children start to go out to work and have their own children.

ACTIVITY: Responsibilities of policymakers – countries with youthful populations

■ ATL

- Critical-thinking skills: Identify trends and forecast possibilities

Imagine you are a policymaker in Niger. You are going to plan what type of services (such as housing, education, health, transport) you think your country will need to invest in for the next 20 years. Your country has 49 per cent of its population under the age of 15, and the population growth rate is 3 per cent every year. The birth rate is 44 live births per 1,000 population. The infant mortality rate is 81 deaths per 1,000 live births; life expectancy is 60 years, and the fertility rate is at 6.49 births per woman, the **contraception rate** is 18.9 per cent and the average age for a woman to have her first baby is 18 years.

Suggest what you will do to try and reduce the percentage of children under the age of 15 in the next two decades or so.

Explain why you have targeted these services to invest in.

Suggest what conflicts could occur due to your spending review.

For more details go to the website: www.cia.gov/library/publications/the-world-factbook/geos/ng.html

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding and Criterion D: Thinking critically.

EXTENSION

Youthful populations can be seen by some as problematic for the future. However, some countries have seen their young population as a resource as they start to reach the working age group, attracting foreign investors – this is known as the **demographic dividend**. Find out more about this: where it is happening and how it is benefiting these countries.

One of the major issues facing many countries is an ageing population – where the proportion of people over the age of 65 or retirement age is relatively high. As the fertility rate in many countries is declining, there will not be enough people of working age to provide income through taxes to finance the services that an older generation needs. This is a problem in Japan, Italy, Germany, Australia and Iceland, for example, where life expectancy is over 80 or higher.

The fertility rate in these countries has lowered over the past 30 to 40 years. Free access to contraception since the 1960s has meant that women have been able to control when they get pregnant. Many women have also gone into higher education and the workplace, which has led to them delaying the age at which they start a family. The infant and child mortality rates have dropped and therefore parents do not need to have as many children. Also, children are expensive. Clothing, nursery fees and after-school care can make it very expensive to have more children, so many couples have just one or two children. Therefore, the birth rate has significantly decreased.

In these circumstances, the critical concern for policymakers is that a growing older population means more money spent on provision for this age group: health treatments for age-related diseases such as certain cancers and Alzheimer's or other forms of dementia, and specialized housing costs for the very old. Younger members of the family might be unpaid carers, or they might have to decide to send their loved ones to a care home, which can put pressure on the family unit.

In some countries, older people move to specific regions. In the UK, this is the case for some seaside towns in the south. For example, in 2014 the BBC website (www.bbc.co.uk/news/magazine-27066299) stated that Christchurch in Dorset had a higher percentage of old people living there than anywhere else in the country; 31 per cent of the population is over 65, and the median age is 69.9 years. As a result, there is pressure to provide certain services in the area. Transport, hospitals and entertainment are focused on the ageing population and there are minimal facilities for the younger generation.

Equally, an ageing population can bring many benefits to a country or region. Many older people choose to work over the retirement age, which on average is 65 years; this can bring benefits to the workplace, as they can provide valuable advice to the younger members of the workforce. In countries where families tend to live near to each other, the grandparents can provide childcare that is free or relatively cheap so that both parents can go out to work.

We must remember when studying ageing populations that there is a big difference between someone who is 65 and someone in their 90s. Modern medical technology makes this difference even more pronounced as people in their 60s and 70s are more likely to survive operations and medical treatment, while people in their 90s have a weaker immune system, which makes them more vulnerable.

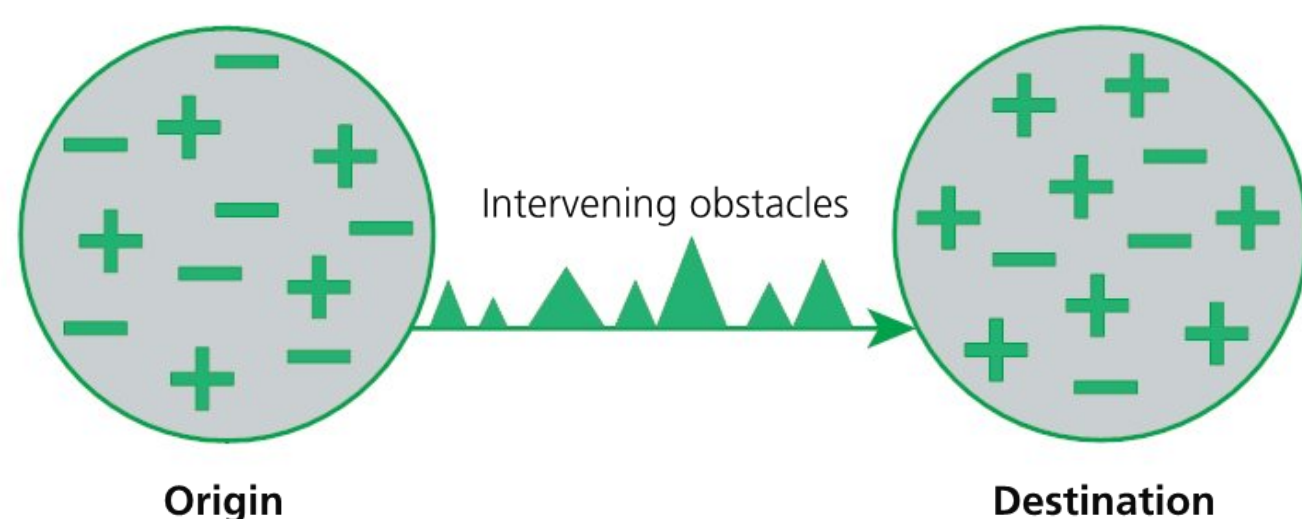
DISCUSS

Discuss how an ageing population can bring both benefits and costs to society on a local and national level.

How does migration affect population?

Migration is the third factor, alongside births and deaths, that affects population growth. Migration is the movement of people; immigration is movement into a country and emigration is movement out of the country. There are many reasons why people move, and for their choice of where to move. Internal migration is when a person moves within a country's border; international migration is when a person is moving across borders. Migration can also be divided into voluntary migration when the person chooses to move, and forced migration when a person is obliged to move because their life is threatened or endangered.

In the case of voluntary migration, Lee's model (Figure 2.14) is used to explain why people move from one place to another. The model suggests that there are negative reasons for a person leaving their place of origin, known as **push factors**, and positive reasons that attract the person to move to the place of destination, known as **pull factors**. There are also intervening obstacles that can stop a person from getting to the place of destination.



■ **Figure 2.14** Lee's model of migration

Most of the time, migration has little impact on the place of origin or the place of destination. However, when many people are migrating, it can have a significant impact on both. When people move to another country (international migration), it is most often for work.

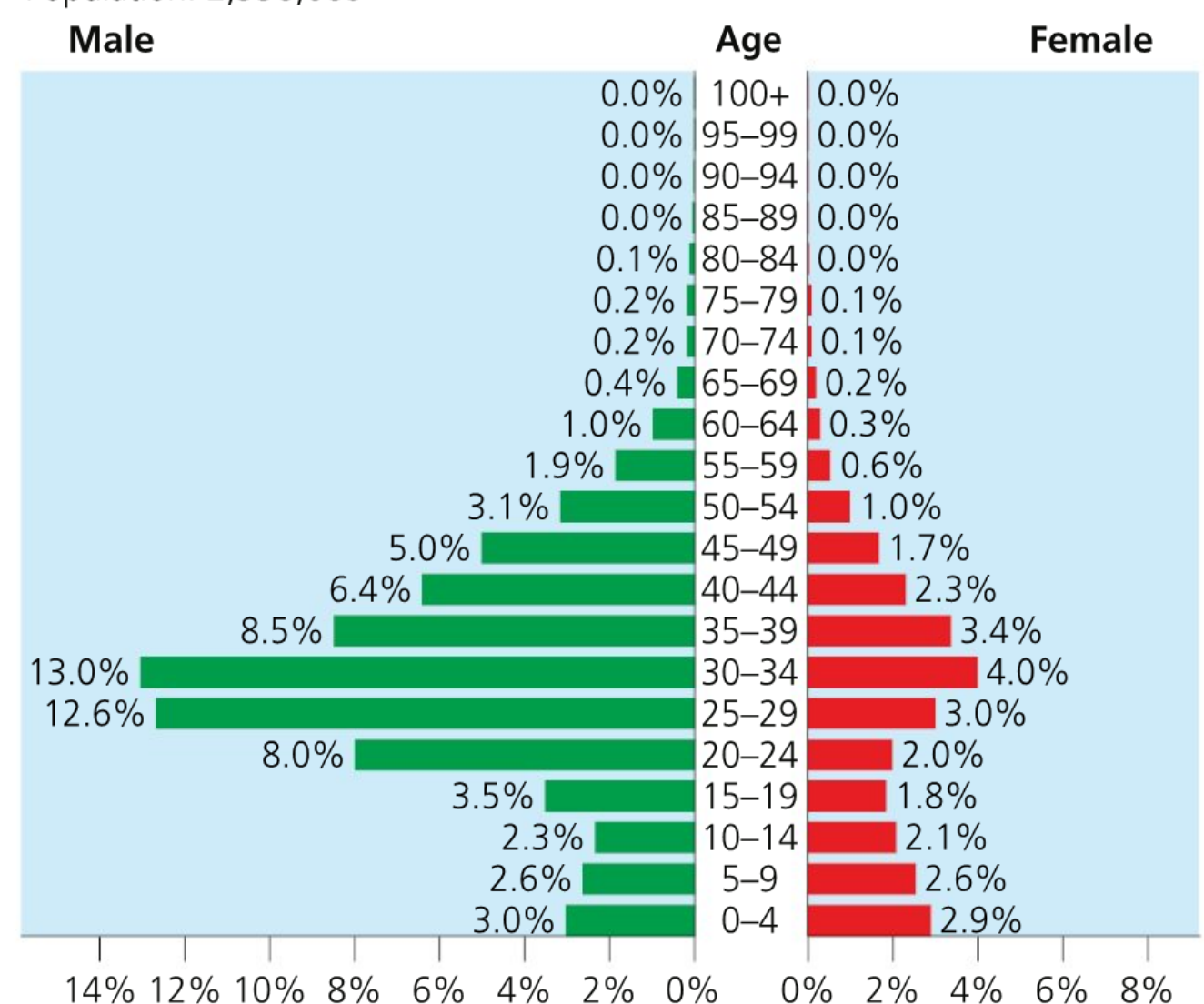
THINK-PAIR-SHARE

Consider the case of internal migration.

Think about the push factors that might lead a young adult to leave a rural village. Think of pull factors that might lead the young person to want to move to a large city. What do you think would be some intervening obstacles that might stop them from moving? Share your ideas with your partner and then to the rest of the class. Are there any factors on which you all agree? Can you **classify** the push and pull factors into social, economic, environmental and political?

Figure 2.15 shows a population pyramid for Qatar. As you can see, the percentage for males aged 20–39 is significantly larger than the female percentage for the same age groups. The reason for this is a large percentage of men moving to Qatar for work, mainly in the building industry – especially for work on the 2022 World Cup stadiums. Most of the migrants are from South Asia. This kind of immigration can have short-term impacts, both positive and negative, on the place of destination and the place of origin. For example, money sent home to the family to spend on education (known as **remittance**) can be positive economically for the place of origin, but it can be seen as economically negative for the place of destination, as money is being taken out (leaked), and is not being spent at the place of destination.

Population: 2,338,085



■ **Figure 2.15** Population pyramid for Qatar, 2017

ACTIVITY: Impacts of migration for place of origin and place of destination

■ ATL

- Collaboration skills: Build consensus
- Communication skills: Organize and depict information logically

Either individually, or in pairs, copy and complete Table 2.5 to show the impacts of migration on place of destination and place of origin. Share your ideas with the rest of the class.

Factor	Place of destination		Place of origin	
	Positive impacts	Negative impacts	Positive impacts	Negative impacts
Social				
Economic				
Environmental				
Political				

■ **Table 2.5** The impacts on place of destination and place of origin

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion C: Communicating and Criterion D: Thinking critically.

Forced migration is when a person feels that they have to leave a place because they feel their life or wellbeing is endangered if they stay. Refugees are people who have been forced to leave their country. Reasons for this are conflict or civil war, persecution, natural disasters and climate change. Internally displaced people (IDPs) are people who find shelter in another part of their country after having been forced to flee their home.

The United Nations for Refugee Agency (UNHCR) has stated:

‘We are now witnessing the highest levels of displacement on record.

*‘An unprecedented **68.5 million** people around the world have been forced from home. Among them are nearly **25.4 million refugees**, over half of whom are **under the age of 18***

*‘There are also an estimated **10 million stateless people** who have been denied a nationality and access to basic rights such as education, healthcare, employment and freedom of movement.*

*‘... nearly **1 person is forcibly displaced every two seconds** as a result of conflict or persecution’ – UNHCR website*

WHAT ARE THE MAIN CAUSES OF FORCED MIGRATION?

There are many reasons why people are forced to leave their homes. Conflict, climate change and ‘land grabbing’ are three main reasons.

- Conflict between countries or civil war has been the primary cause of refugees. Examples of countries that have had a conflict or civil war in the last 20 years are Syria, Afghanistan, Sudan, Somalia, Rwanda and the Democratic Republic of the Congo (DRC), to name but a few.
- Climate change is affecting many parts of the world. People flee regions that suffer from drought (not enough rainfall) or rising sea level, where the land is disappearing altogether. Sub-Saharan Africa’s semi-arid regions, such as South Sudan and Chad, have experienced extensive desertification (when the land becomes like a desert) because of drought. Some Pacific islands are losing land due to the sea level rising; there will be a time when these islands will disappear, and a whole nation will have lost its land.
- **Land grabbing** is when land is taken over by governments, companies or individuals for economic reasons. People living in these areas are then forced to move. Amazonian **indigenous** groups, who do not have any legal rights to the land where they live, but who have been in the area for generations, have to leave the area and, in some cases, have been killed if they do not.

ACTIVITY: Why do we need to move?

■ ATL

- Information literacy skills: Access information to be informed and inform others; Make connections between various sources of information

Choose one of the three causes of forced migration: conflict, climate change or land grabbing.

Investigate an example of the forced migration you have chosen.

State the location of your example.

Explain the causes of the forced migration, giving evidence from your research.

Below are some examples of news websites you might wish to use to begin your research:

Conflict: www.theguardian.com/global-development/2015/jul/09/syria-refugees-4-million-people-flee-crisis-deepens

Climate change: www.theguardian.com/environment/2018/mar/19/climate-change-soon-to-cause-mass-movement-world-bank-warns

Land grabbing: Farming in Africa: www.bbc.co.uk/news/world-africa-17099348

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding, Criterion B: Investigating, Criterion C: Communicating and Criterion D: Thinking critically.



■ **Figure 2.16** Babussalam refugee camp in Azaz, Syria, 2018

MAKING IT FAIR: NOW, THEN, LATER

What rights and responsibilities do we share for people who have been forced to move?

In groups, consider the case studies you have been studying and think about some issues that might have affected the people who have been displaced from their homes and communities. Write these down.

Brainstorm how you would make it fair for them before they left and when they are away from their home.

Sort your ideas and actions into what you could do now, and for the future.

Evaluate the ideas or actions: which are feasible? Which are the most appropriate? In your groups, **present** your ideas or actions to the rest of the class.



! Take action: Reaching out to refugees

■ ATL

■ Collaboration skills: Make fair and equitable decisions

- ! The UN Refugee Agency (UNHCR) World Refugee Day is 20 June.
- ! Take action to raise awareness by preparing a class assembly or even a whole week of events to highlight the plight of displaced people around the globe. **Explain** the causes and consequences for displaced people and highlight awareness of their rights as refugees.
- ! Take action to help. If there is a local charity that helps refugees, invite a representative in to talk to the broader school community about what you can do to raise awareness.
- ! Take action directly. Are there refugees who live near to you? What help could you and your school community give them? Work with charities or non-governmental organizations to find out how you can help directly. Could they use language classes? Do they need clothing or food? Could they use advice or help about how to live within your local community?

EXTENSION

'A Refugee Olympic Team will compete in the Tokyo 2020 Games, following the ground-breaking debut of refugee athletes in the Rio 2016 Summer Olympics.'

– www.unhcr.org

Sport is a way for people to come together. In 2016, the first Refugee Olympic team, comprising ten refugees from four countries competing as one, took part in the Rio de Janeiro summer Olympics.

Find out more about the ten members of the 2016 Refugee Olympic team. What countries did they leave? What were the reasons for them fleeing their home country? What consequences do they face as refugees?

Use these websites to help with your research:

- www.olympic.org/news/refugee-olympic-team
- www.unhcr.org/news/latest/2016/8/578e20187/countdown-rio-2016-refugee-olympic-team-prepares-historic-debut.html

What rights and responsibilities must be considered for future populations?

Many countries at some point have tried to manage population change. Sometimes it can be done by changing the age of dependence of the ageing generation, for example by increasing the retirement age by a year or so. This has recently happened in the UK; the retirement age will go up from 65 years to 66 in 2020 and then to 67 between 2026 and 2028. Other countries with an ageing population are also changing their retirement age; not all are happy about it, especially those who are faced with the prospect of working until they are older, although some more elderly people welcome this as an opportunity. Other countries have tried to encourage immigration by people of working age, since their work will generate tax revenues and therefore pay for the older generation's retirement.

Some countries have tried to encourage people to have more children. This is known as a **pro-natalist policy**. The government gives perks to people who have larger families – this means three or more children, since to achieve an increase in population, each couple needs to produce more than the two children required to replace themselves. In France, if you have a third child, the state supports cheaper nursery fees, longer paid maternity leave, fewer taxes and special discounts. The more children you have, the better discounts you get. The consequence of this is that France's fertility rate has increased, and in 2016 it was the highest in Europe at 1.96 children per woman, while the average age for a woman to have their first child was 28.1 years (2010).

In some cases, governments have discouraged people from having more children. China in 1979 introduced the one-child policy. This was due to rapid population growth during the 1950s, when people were encouraged to have large families. The population decreased due to the famine of 1959–61. Afterwards larger families were encouraged again. The average fertility rate during the 1960s was six

DISCUSS

What do you think a government should do when facing population challenges such as an ageing population, or the risk of an overpopulated country? Is it a human right for individuals or couples to have as many children as they wish?

In pairs, brainstorm your views on this. **List** as many rights related to reproduction as you can think of, and as many responsibilities that parents and individuals in societies carry.

Show the balance of rights and responsibilities using a visual organizer such as a see-saw or weighing balance, with rights on one side and responsibilities on the other.

Do all rights 'weigh' as much as all responsibilities? Or do some carry more weight?

Which way would the balance fall for you?

children per woman. This population explosion meant the government had to reduce the fertility rate or confront **overpopulation**. A law was passed prohibiting families from having more than one child. (This is known as an **anti-natalist policy**.) Later, in 2005, people in the countryside were permitted to have a second child, if their firstborn was a girl. This stopped in 2016, and now people are allowed to have two children.

This policy has had consequences that China will feel for generations to come. Many people wanted to have a boy in order to keep the family name, so many girls were aborted, a practice known as **female infanticide**. As a result, the gender balance is skewed. There has also been a generation of children who have no brothers or sisters; these have been called little emperors or empresses. A large proportion of men will never have a wife, due to the difference between the number of men and women. Many women had to have forced abortions if they were pregnant with their second child. All couples had their fertility checked on a regular basis, and had to ask permission to try for a child.

After nearly 40 years of the one-child policy, the Chinese government has achieved its aim in reducing the population growth. However, China now faces a new challenge of a substantial ageing population, and very few young people to look after them.

CHALLENGE AND EXTEND

Review the questions from the beginning of the chapter.

Challenge: What is still challenging or confusing for you to get your mind around? What questions, wonders or puzzles do you have now?

Extend: What further study could you go forward with now?

Reflection

In this chapter, we have we have **explored** how the patterns and trends of population growth have changed over time and **analysed** the reasons for the changes and the impacts. We have **evaluated** how governments have tried to control the population in their country. We have also **explored** the causes and consequences of migration and our rights and responsibilities in terms of population management. We have **taken action** by raising awareness of the link between population growth and poverty and the impacts of forced migration.

Use this table to reflect on your own learning in this chapter.					
Questions we asked	Answers we found	Any further questions now?			
Factual: Where are all the people? How do we measure population growth?					
Conceptual: How do we represent population trends and patterns? What processes are driving trends and patterns of population growth? Why is it difficult to manage population? How does migration affect population?					
Debatable: What rights and responsibilities must be considered for future populations?					
Approaches to learning you used in this chapter:	Description – what new skills did you learn?	How well did you master the skills?			
		Novice	Learner	Practitioner	Expert
Collaboration skills					
Communication skills					
Critical-thinking skills					
Information literacy skills					
Learner profile attribute(s)	Reflect on the importance of being a good inquirer for your learning in this chapter.				
Inquirer					

3

Where are the city limits?



- Urban areas work as **systems** that emerge in particular places and at particular times, due to a variety of reasons, but their sustainable development requires managed intervention.

CONSIDER THESE QUESTIONS:

Factual: What is urbanization? Where are all the megacities?

Conceptual: Why has urbanization increased and what are the consequences? What have governments and other social agents done to improve lives for people living in the cities?

Debatable: Can urban areas ever be managed sustainably?

Now **share and compare** your thoughts and ideas with your partner, or with the whole class.

IN THIS CHAPTER, WE WILL ...

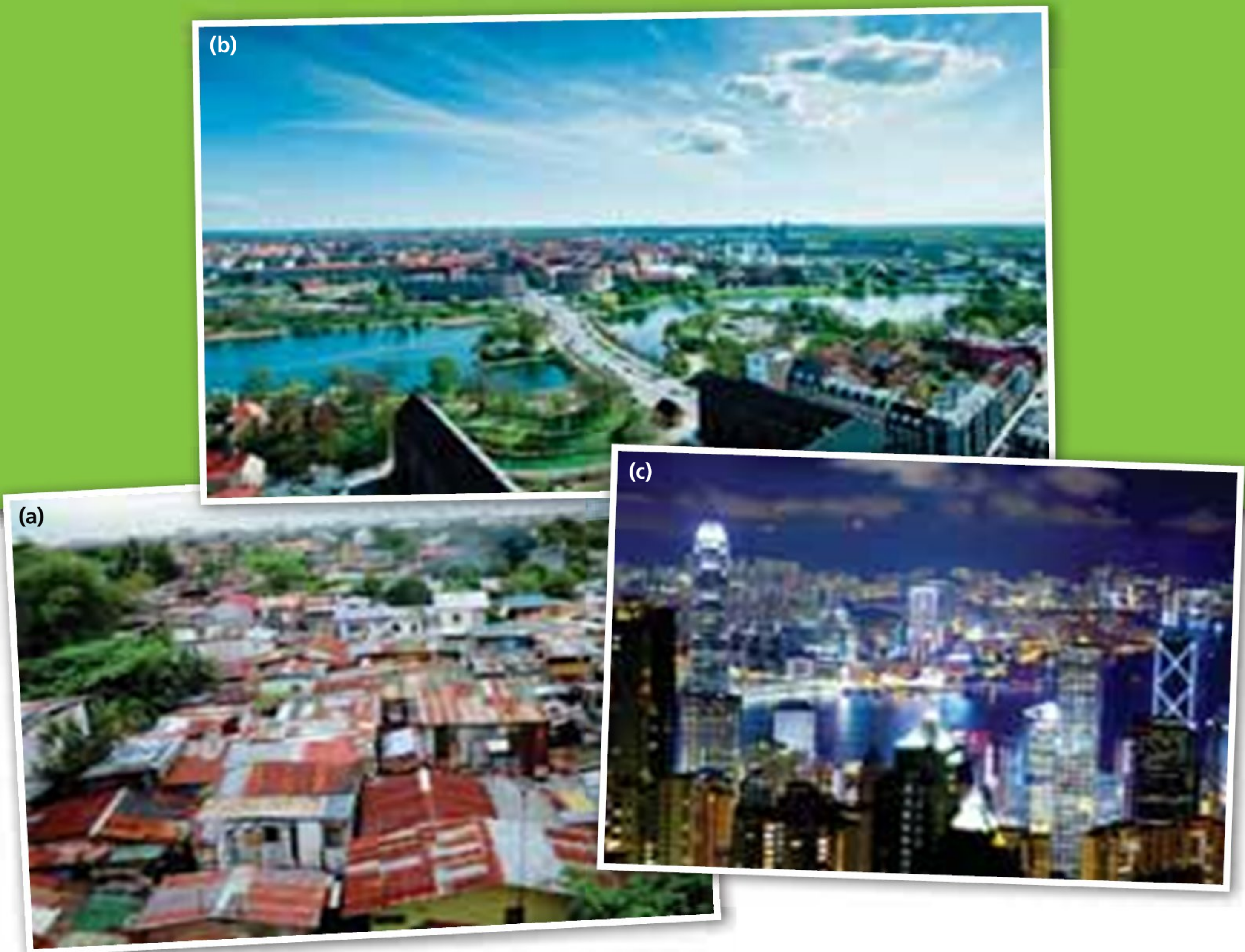
- Find out** how where the main urban growth has occurred in the past 40 years.
- Explore** how cities around the world have tried to become more sustainable.
- Take action** by promoting sustainable urban projects.

These Approaches to Learning (ATL) skills will be useful ...

- Collaboration skills
- Communication skills
- Critical-thinking skills
- Information literacy skills

Assessment opportunities in this chapter:

- Criterion A: Knowing and understanding
- Criterion B: Investigating
- Criterion C: Communicating
- Criterion D: Thinking critically



■ **Figure 3.1** (a) A shanty town, (b) Copenhagen, (c) Hong Kong at night

● We will reflect on this learner profile attribute ...

- Knowledgeable – we will try to understand what we need to do improve the lives of people in urban areas around the world.

KEY WORDS

inner city
rural
urban

SEE–THINK–WONDER

What do you see in the images in Figure 3.1?

What might connect these images? What might make them different from one another? What might it be like to live in these places? What would be good?

What would the challenges be? Share your answers with the rest of the class.

Around 60 per cent of the world's population now lives in urban areas. Furthermore, ever greater numbers of people are migrating into urban areas, which is putting tremendous stress on the **infrastructure**, the amenities and the health of many who live in these places. In this chapter, we will explore the rapid growth of cities, and consider to what extent urban development can be achieved sustainably.

What is urbanization?

A settlement is a place where people set up home to live. Settlements develop over time, and their use can change during this time. According to the website <https://ourworldindata.org/urbanization>, in 1600, the world population living in urban areas was just less than 5 per cent. However, as of 2015, more people now live in urban areas, including cities and **megacities**, than in rural areas. According to the United Nations Development Programme (UNDP), in 2050, 6.5 billion people will live in cities, that is 3 billion more than live in cities today. Issues with urban living are taken seriously by the UN, to the extent that Sustainable Development Goal 11 is *Sustainable cities and communities*

Why has this increase in urban growth occurred and why do so many people think that urban living is better than rural life?

In Chapter 2, we have seen why people migrate from rural to urban areas. There are many push factors away from rural areas (why people want to move away), such as lack of jobs, little education, inadequate housing, food insecurity and lack of doctors. Pull factors (the perceived reasons why people want to move to an area) include job opportunities, better education, better quality housing, proximity to doctors and better access to food. On balance, urban areas tend to be perceived more positively than rural areas and, as a result, there is a net migration into them.



■ **Figure 3.2 (a)** Rural area



■ **Figure 3.2 (b)** Urban area in a UK city



■ **Figure 3.2 (c)** Urban green space: rooftop gardens

Where are all the megacities?

WHAT MAKES YOU SAY THAT?

Study the three maps in Figures 3.5 (a), (b) and (c).

Answer the following questions as a group or as a class.

- 1 What is going on? Describe what you see in the three maps. Compare and contrast the maps. Which countries have always had more people living in urban areas since the 1950s? Which countries only have a majority of people living in rural areas in the projected map of 2046?
- 2 What makes you say that? What do you know about this topic? What ideas do you have as to why there has been an increase in the number of people living in urban areas? Can you explain the reasons for an increase in people living in urban areas? Can you think of links to other geography topics that you have studied, or might study in the future?

As people have migrated to the urban areas, these settlements have grown to such sizes that new names have been created for them. Large towns that grew in size and started to grow into each other become **conurbations**. One such **agglomeration** is the Greater Tokyo Area, also known as Shutooken. It has an estimated 38 million people and includes the cities of Yokohama, Chiba, Kawasaki, Saitama and Sagami-hara. Many large conurbations are now known as megacities. For a settlement to be classed as a megacity, it must have a population of over 10 million.

The settlement hierarchy model in Figure 3.3 suggests that when the population increases, so do the number of services that the settlement provides. With the increase in the number and **range of goods and services**, the settlement becomes more attractive to people, so more people then move in. More people also travel to the settlement, giving it a larger **sphere of influence**.

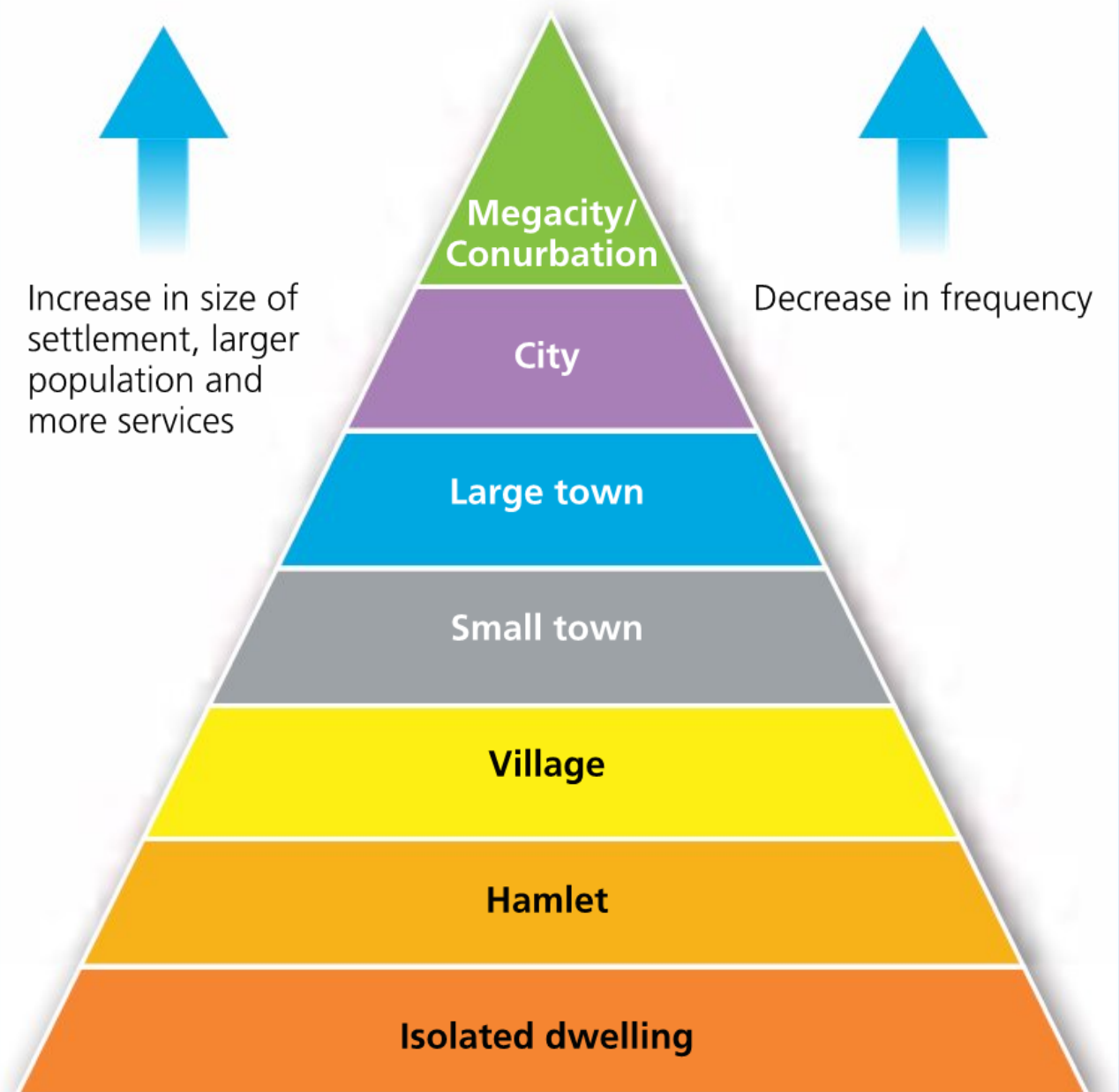
This movement of people puts pressure on the city, as more people moving in means an increased need for jobs, education, doctors, etc. and more people using transport. In many cases, more people migrate into the city than the services can support. This change causes many problems for urban areas.

Thinking critically about models

Models are essential in geography; as in other areas, they show a simplified version of the more complex real world. Simplified models help us make **predictions** and so better understand the very complex world around us.

However, this process of simplification can introduce flaws or inaccuracies, and all models must be considered critically.

Figure 3.3 shows a **settlement hierarchy** model. This model gives a simple visual representation of how services increase when the population increases and the types of each settlement in the hierarchy. There are, however, some settlements where the population is high, but the number of services is low.



■ Figure 3.3 Settlement hierarchy model

ACTIVITY: Settling down

■ ATL

■ Communication skills: Make inferences and draw conclusions



■ **Figure 3.4** An OS map of south-east area of Derby, UK

You can find the legend to OS 1:50,000 scale maps at:
www.ordnancesurvey.co.uk/docs/legends/50k-raster-legend.pdf

- 1 Using any sort of map (electronic or hard-copy), **find** examples of the following settlement types in your home country:
 - a Isolated dwelling
 - b Hamlet
 - c Village
 - d Small town
 - e Large town
 - f City
 - g Conurbation/megacity
- 2 Using online tools, **find** the population total for each type of settlement that you have found.
- 3 **Describe** the main physical features you **find** in or near the hamlet, village and town.

- 4 **State** the main services (such as railway, post-office, shop) you **find** in the hamlet, village and town.
- 5 **Suggest** the relationship between the number of services and the population size.
- 6 Research to find out what is meant by **sphere of influence** and **range of goods and services**. Can you think of any settlements where there might be a large population, but few services?
- 7 **Evaluate** how useful the settlement hierarchy model (Figure 3.3) is for showing us settlement hierarchy.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding.

WHERE IS THIS INCREASE IN URBANIZATION OCCURRING NOW?

The maps in Figures 3.5 show an increase in the percentage of people living in urban areas per country. We can see that in 1950 there were about 20 countries that had more people living in urban areas. The projection for 2050 shows that there will only be approximately 17 countries that have more people living in rural areas. We can see where most of the urbanization is projected to happen. These are mainly in the Sub-Saharan Africa and East African regions and South and South East Asia. Most of these countries are LICs or MICs, and with this rapid urbanization comes many social, economic, environmental and political problems.

DISCUSS

Compare Figures 3.5 a, b and c. Where has the main urbanization occurred since the 1950s? What reasons might there be for urban growth in these regions? What issues could arise due to this rapid urban growth? How do you think some of the issues could be solved?

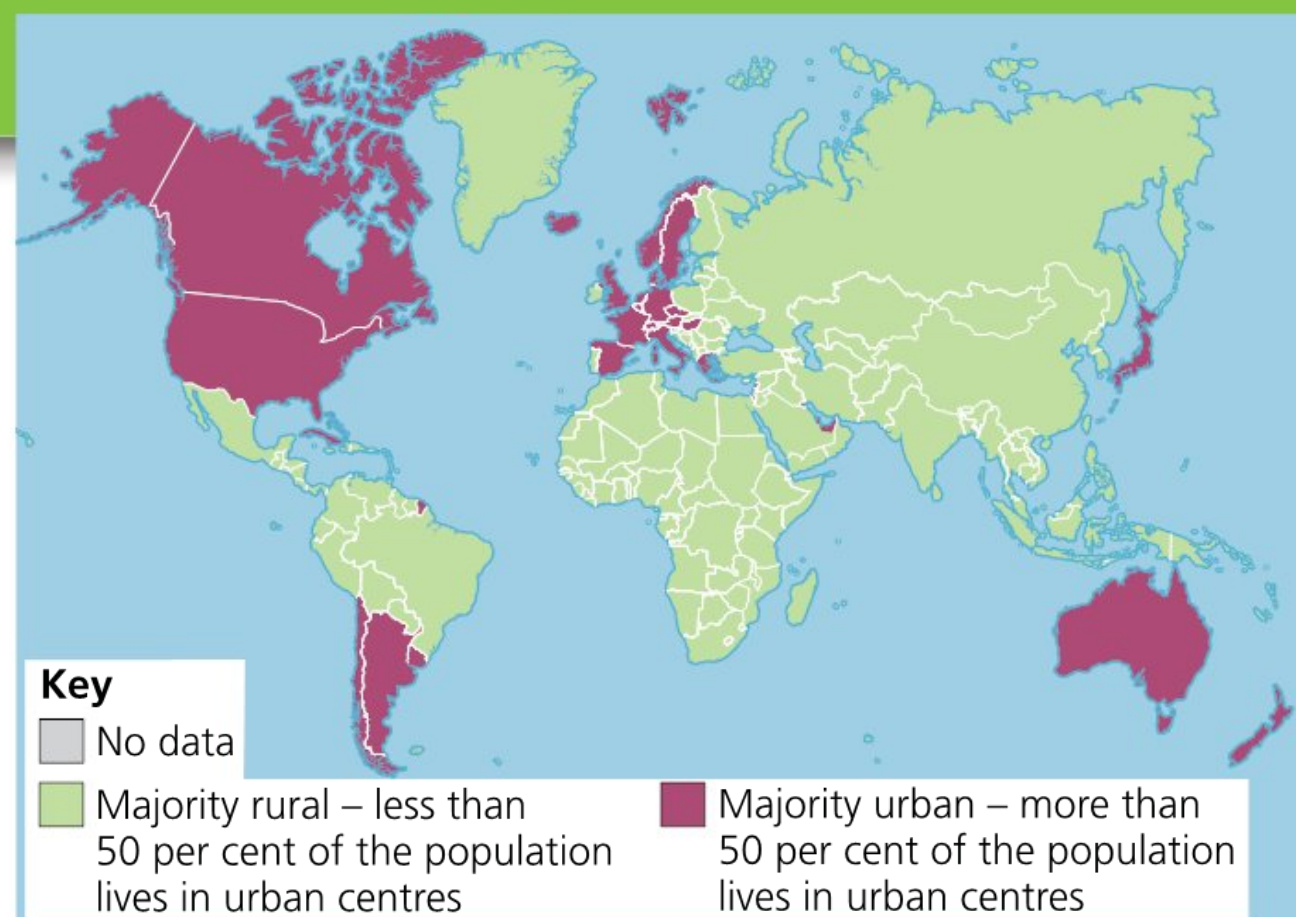


Figure 3.5 (a) Urban and rural areas, 1950

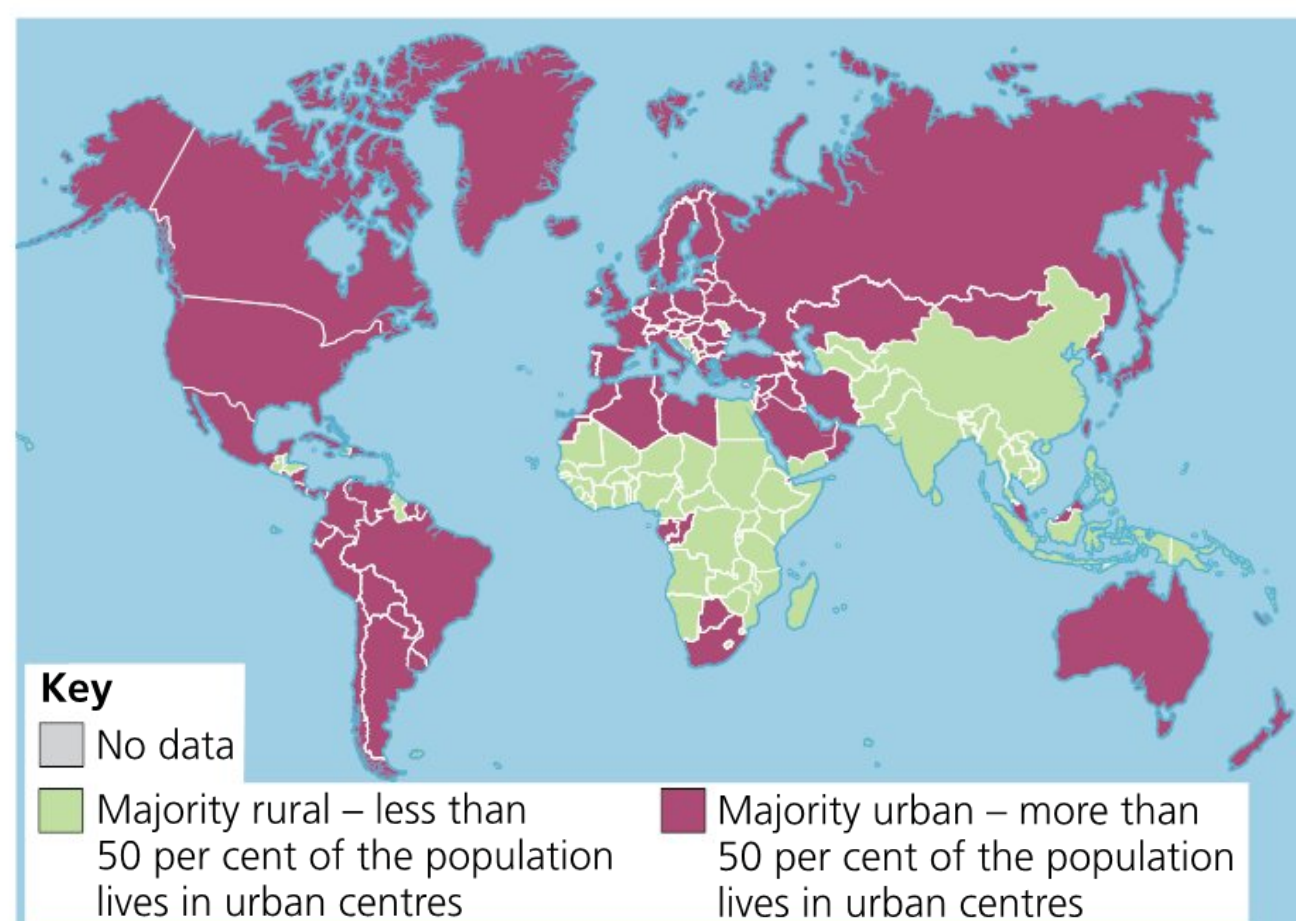


Figure 3.5 (b) Urban and rural areas, 1999

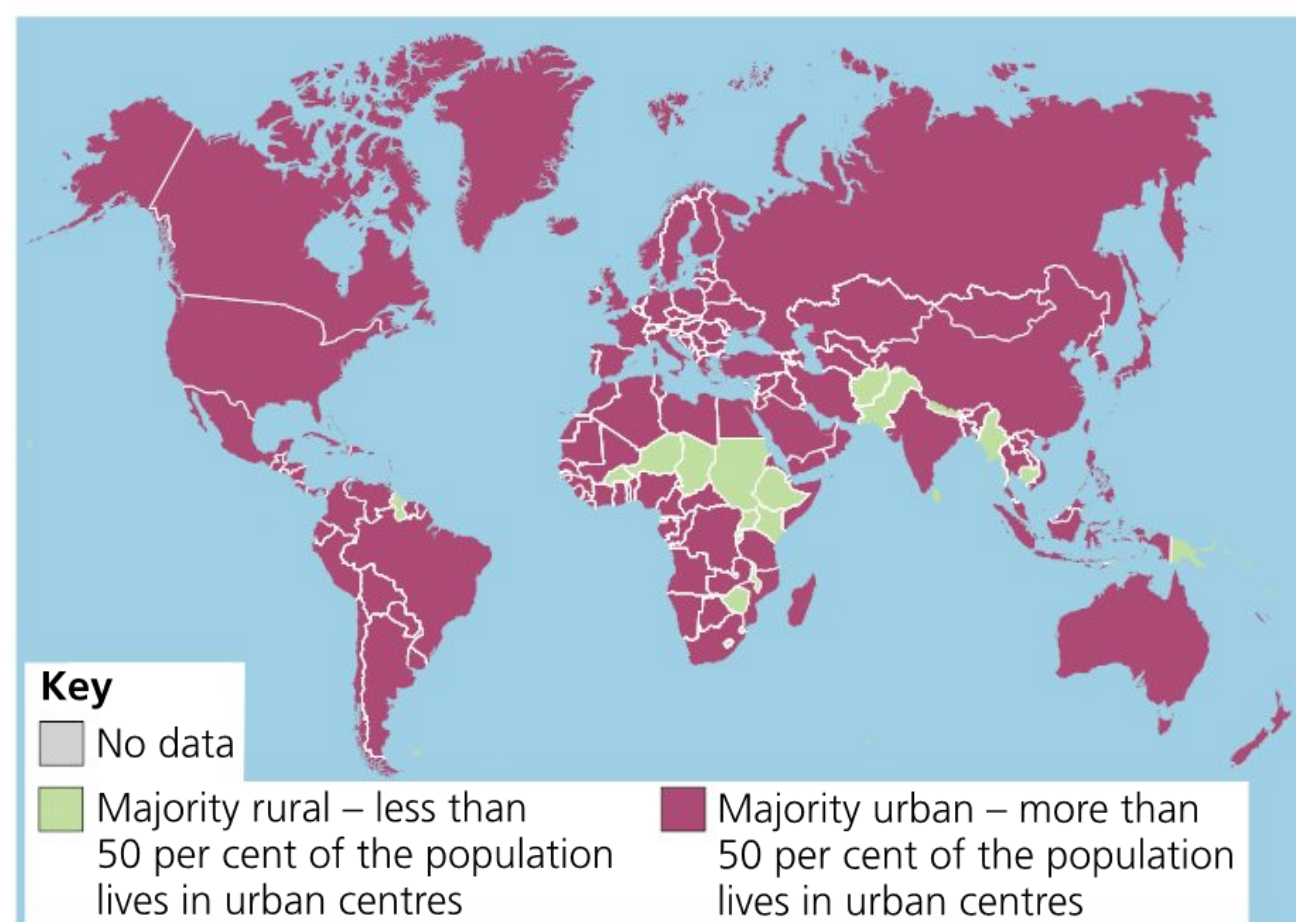


Figure 3.5 (c) Projected urban and rural areas, 2046 (based on estimates to 2016, combined with UN projections to 2050)

LAND USE MODELS

Simplified models are also used to show different regions within an urban area. Burgess and Hoyt are the two most common urban **land use** models:

ACTIVITY: Exploring land use with models

■ ATL

- Information literacy skills: Access information to be informed and inform others

Analyse the two land use models shown in Figures 3.6 and 3.7. Make sure you understand the terms used in the different models, for example: **CBD**, **inner city**, factories, low-class housing, high-class housing.

Using an online map, research a city that you know, or one that you are interested in or would like to visit.

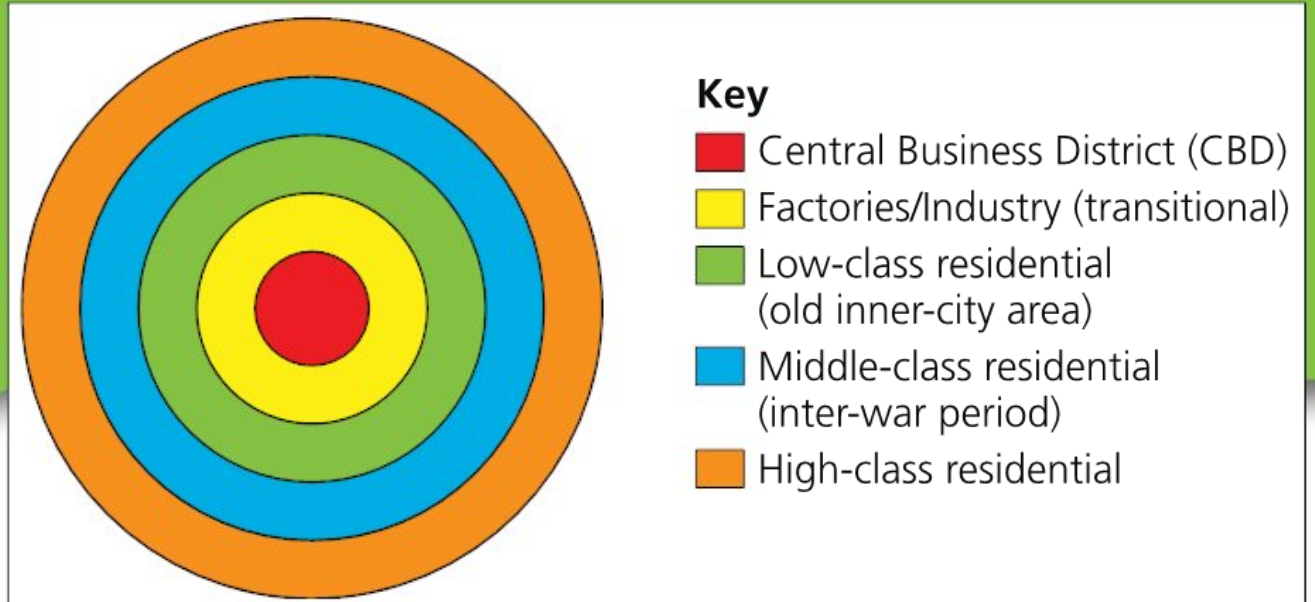
For the city you have chosen, **identify** the following types of land use: CBD, inner city, factories, poor housing, rich housing. **Sketch** a map of the city and show these on your sketch.

Compare and contrast your map with the land use models of Burgess and Hoyt. What can you see is similar and what can you see that is different?

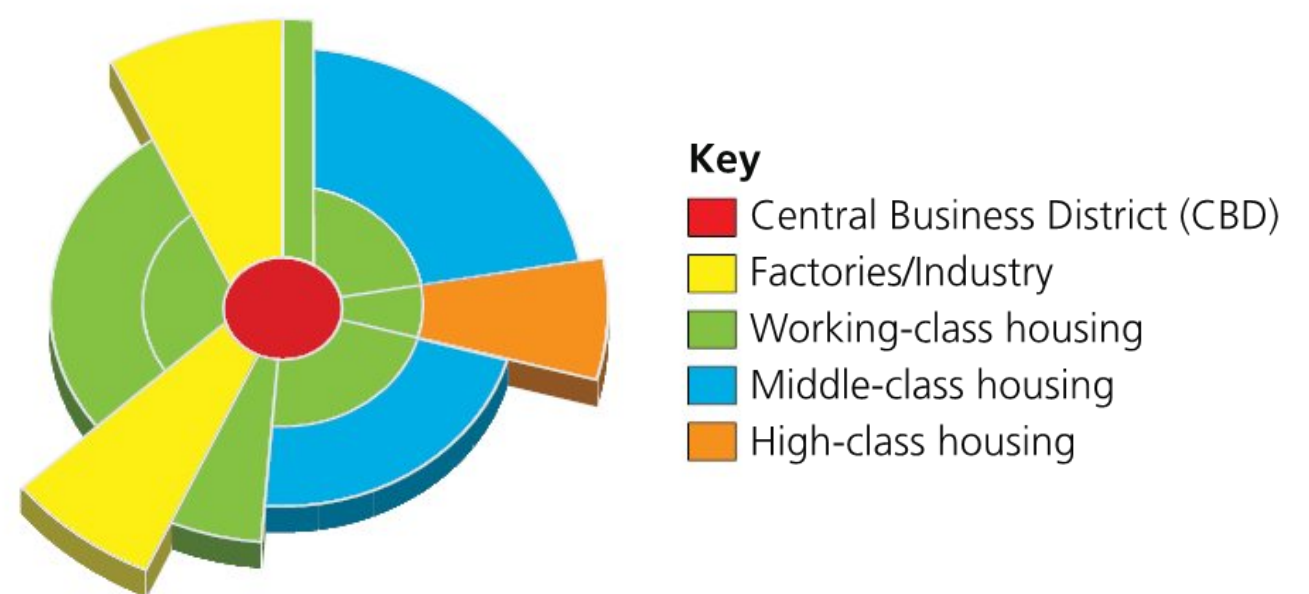
Suggest your own land use model, using the information from the city you have researched.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.



■ **Figure 3.6** The Burgess model



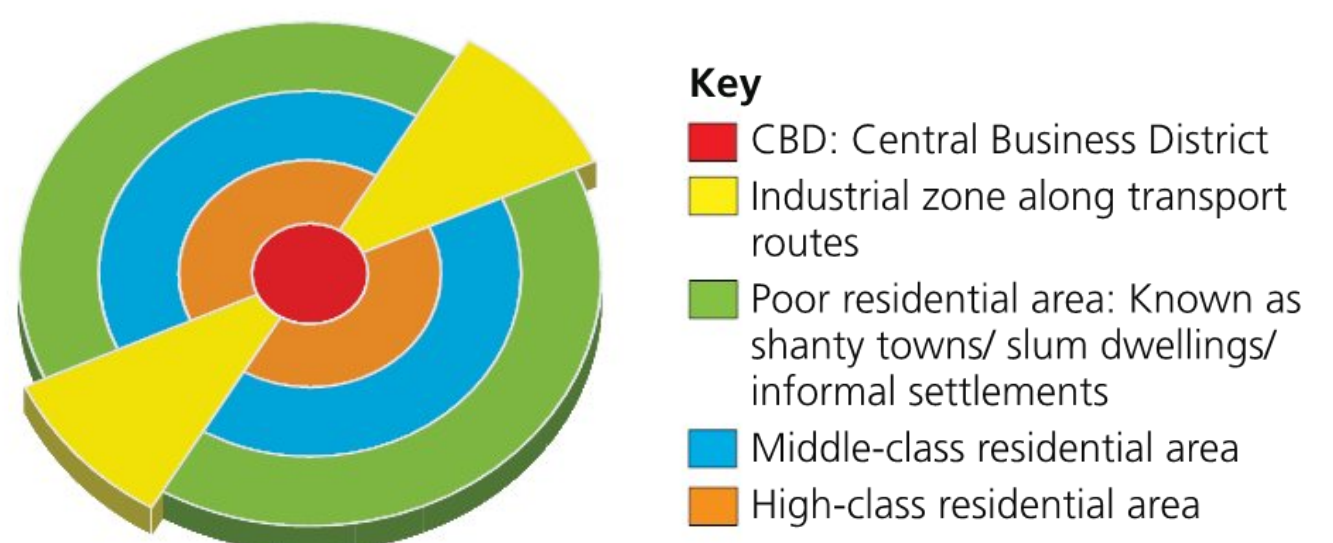
■ **Figure 3.7** The Hoyt model

EXTENSION

Find out more about Burgess and Hoyt by searching **Ernest Burgess geographer** and **Homer Hoyt geographer**. What cities did they use to develop their land use models?

Discuss how the perspectives, backgrounds and concerns of the modellers might affect the kinds of models they produce.

Over time, new models are developed and older ones are adapted for different places. Figure 3.8 is one such land use model. This was developed to represent cities that have experienced rapid **urbanization** **low-income countries (LICs)**, or **middle-income countries (MICs)**, for example Sao Paulo, Brazil.



■ **Figure 3.8** An urban land use model for low-income countries

EXTENSION

Find out more about megacities with this TED talk: <https://youtu.be/U7y4GlmwPLQ>

ACTIVITY: Using GIS to investigate the changes in the distribution of the world's megacities

■ ATL

- Critical-thinking skills: Identify trends and forecast possibilities

Use ArcGIS Online to help you **investigate** the changes in the distribution of the world's megacities.

- 1 First, you need data to help you show on your map how the distribution of the largest cities has changed since the 1950s. Go to this page from the UN to access the required data: <https://population.un.org/wup/Download/>
Follow the steps on pages 57–60.
 - a Click on *Urban Agglomerations* and then download data from the link circled in Figure 3.9.



■ **Figure 3.9** Downloading data on urban agglomerations

- b Download the database as a spreadsheet. It should look like Figure 3.10.

■ **Figure 3.10** Urban agglomerations spreadsheet

- c Delete the box circled in Figure 3.11.

■ **Figure 3.11** Deleting unwanted cells

- d Also, delete the blue header with the UN logo. Your spreadsheet should look like Figure 3.12.



■ **Figure 3.12** Deleting unwanted cells

- e You are now going to create separate spreadsheets for different time periods (1950s, 1960s, 1970s, 1980s, 1990s, 2000s, 2010s, 2020s, 2030s).

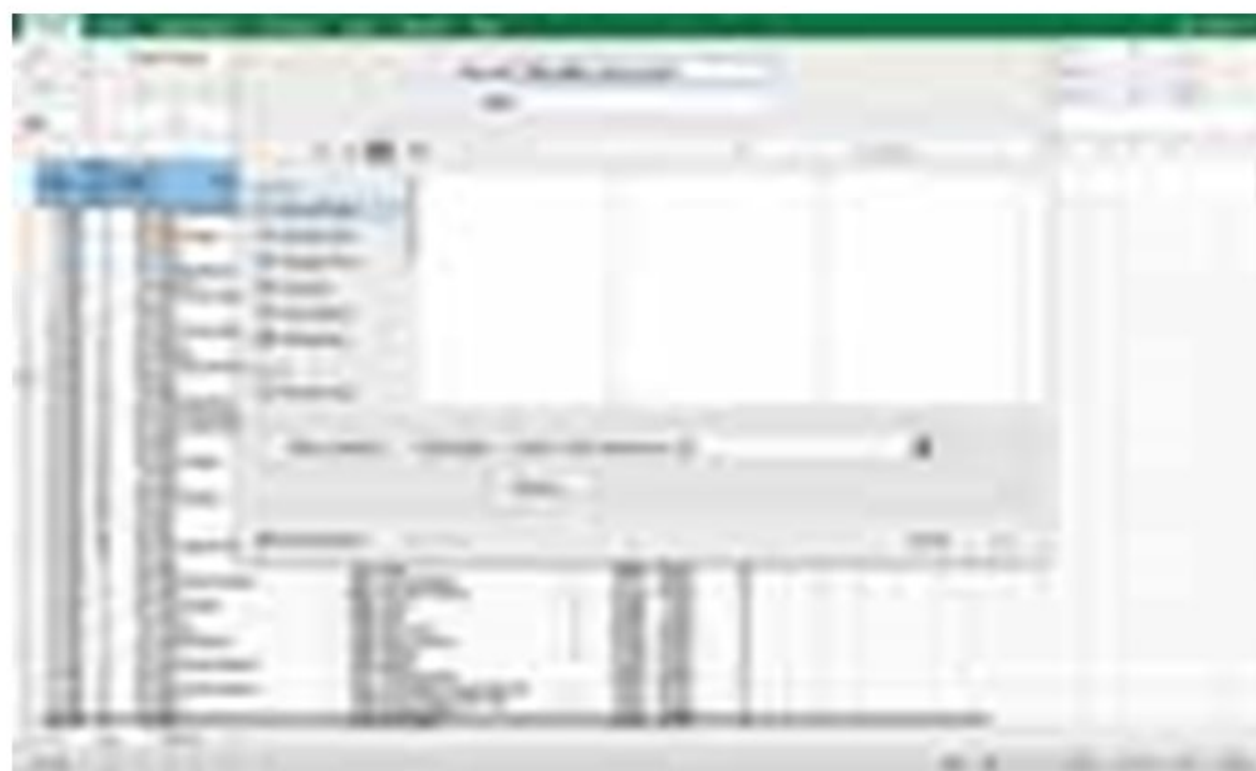
To do this, you have to make sure that the year column is ranked in ascending order (it should be already) as shown in Figure 3.13.



■ **Figure 3.13** Years ranked in ascending order

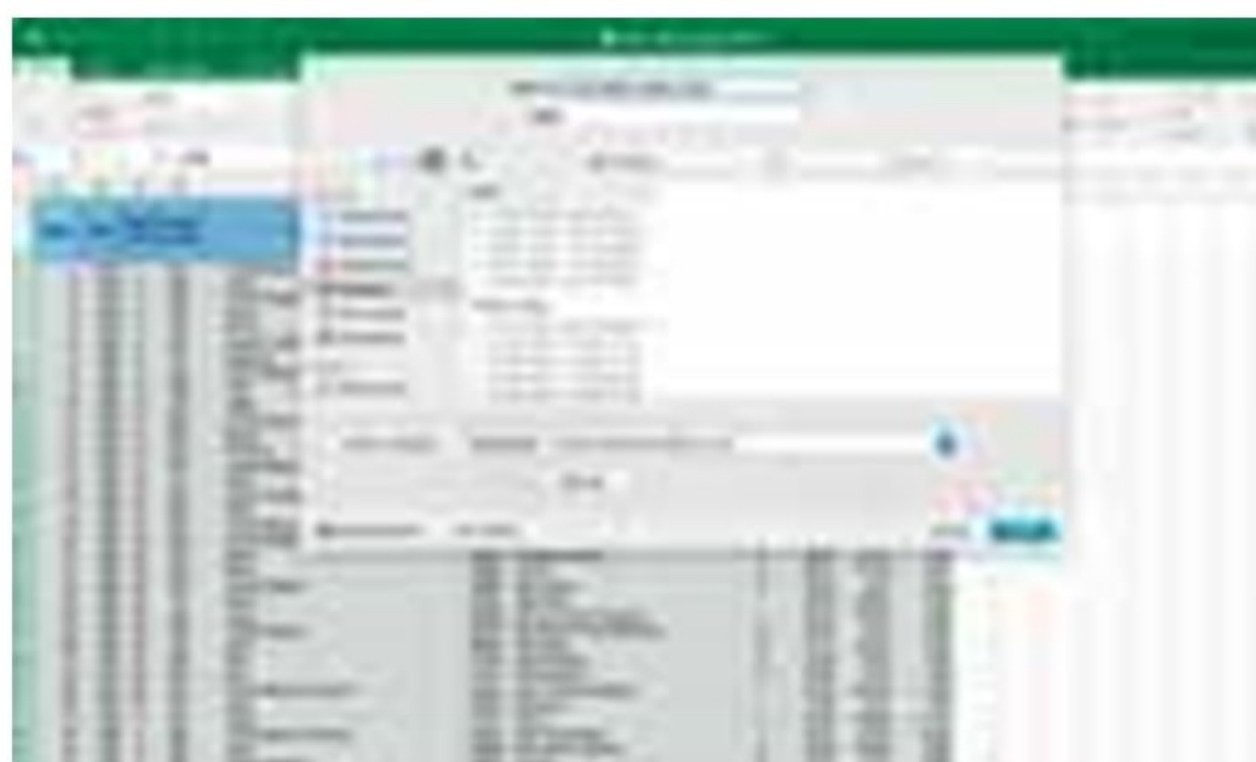
- f Save your spreadsheet in a computer folder titled 'Megacities' and name your file as 'Master'.

- g Then highlight all the rows from 1960 and beyond and delete them. The only years left should be 1950 to 1955. Save this spreadsheet as '1950s'. But make sure you save this file not as .xls but as .CSV. (You will export this .CSV file into ArcGIS Online.)



■ **Figure 3.14** Saving the 'Master' file

- h Repeat the same steps for the following time periods (1970s, 1980s and so on), always using your 'Master' spreadsheet.



■ **Figure 3.15** Saving file as .CSV

- 2 Now you are going to learn how to import your database on ArcGIS Online.
 - a Go on the ArcGIS Online home page, sign in with your free account and click on *Home* and then *Map*. On your map designing page, upload the megacities data from each of the 'year' files you have just created. To do this, click on *Add* for adding content to your map and *Add content from file*.



■ **Figure 3.16** Adding a layer from a file

- b Click on *Browse* and select your first 'years' data (the 1950s one), then click on *Import layer*.



■ **Figure 3.17** Importing a layer

- c You should now have a map of the world with a lot of proportional circles showing the location of the world's largest cities in the 1950s (see Figure 3.18).



■ **Figure 3.18** Map showing largest cities in the 1950s with proportional circles

- d Repeat the same steps for all the 'years' .CSV files. Each uploaded file will create a 'year' layer on your map.
- 3 Your task is now to **design** a map showing the change in the distribution of the largest cities between 1950 and 2030.
 - a Your map must show the location of the ranked cities (starting from rank 1 which should have the largest symbol). For this, you need to choose appropriate map symbols from the *Change style* option (see Figure 3.19).



■ **Figure 3.19** Changing map style

- b First you need to select the attribute (the data) you want to show on your map. Click on the drop-down menu next to *1 Choose an attribute to show* and select your data. In Figure 3.20, we are selecting *Rank order*.



■ **Figure 3.20** Selecting the *Rank order* attribute

- c Once you have selected the attribute *Rank order* you will get a map with default map symbols as in Figure 3.21. The map symbols with proportional circles are appropriate but we want to show rank 1 cities with the largest circle. (Think about why this is.) To do this, you must click on the *Invert* button.

To change your map symbols, go to *Select a drawing style* and click on the *Options* of the map symbols you are using. Then click the *Invert* button.

The rank 1 cities should have now the largest circle.



■ **Figure 3.21** Map showing largest cities in the 1950s by rank order

- d You have now created a *new layer* on your GIS map. Before you can add another layer with a new *attribute* and a new map symbol, it is important to name the layer you have just created with the name of its attribute. To do this, click on the three little blue dots at the end of your layer (the one with the tick) to get *More options* (see Figure 3.22).



■ **Figure 3.22** The layer *More options* menu

- e Click, and then on the drop-down menu, click on *Rename* and give your layer its name, in this case '1950' (see Figure 3.23).



■ **Figure 3.23** Renaming a layer in the *More options* drop-down menu

- f Now you have got a layer called '1950 Largest cities'.
 - g To create a new layer, showing 1970s, 1980s, etc., repeat the steps from the beginning of step 2. Add a layer, import a layer from a file and so on. Do not forget to rename your new second layer with the name of the attribute you have chosen.
 - h In order to see your first fully completed map you must save your map, by clicking on *Save floppy disk icon* and then *Save as*. You need to give your map a tag so it can be saved.
- 4 Working in pairs, **discuss** the following, using your ArcGIS Online map:
- Which cities have remained megacities since the 1950s? In which part of the world are they located? **Suggest** reasons why some cities may have kept their rank since the 1950s.
 - Which cities became megacities after the 2000s? In which part of the world are they located? **Suggest** reasons why some cities have grown so rapidly.
 - **Predict** which cities will become the largest cities by 2050 and which cities will shrink.

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding, Criterion B: Investigating and Criterion D: Thinking critically.

Why has urbanization increased and what are the consequences?

Since the 1950s, urbanization has tended to occur rapidly in low-income countries. There are many complex reasons for this, including rapid natural population growth, and the fact that many urban areas have been seen as offering opportunities which have encouraged people to migrate to them, such as jobs, housing and the chance of a new lifestyle.

Many people in the low-income countries who have migrated into these megacities have, in fact, found themselves in areas that do not have better housing, new job opportunities, better education or access to better health care. Indeed, many have ended up in very poor areas, often known as **shanty towns**.

SEE-THINK-WONDER

Look at the photos in Figure 3.24. **Describe** what you see. What do you think about the experience of living in these areas? What does it make you wonder about how these areas can be made more sustainable?



Figure 3.24 (a) A shanty town in Asia, (b) Favela (slum) da Rocinha in Rio, Brazil, (c) a crowded city street in Europe



A megacity is a city with over 10 million people.

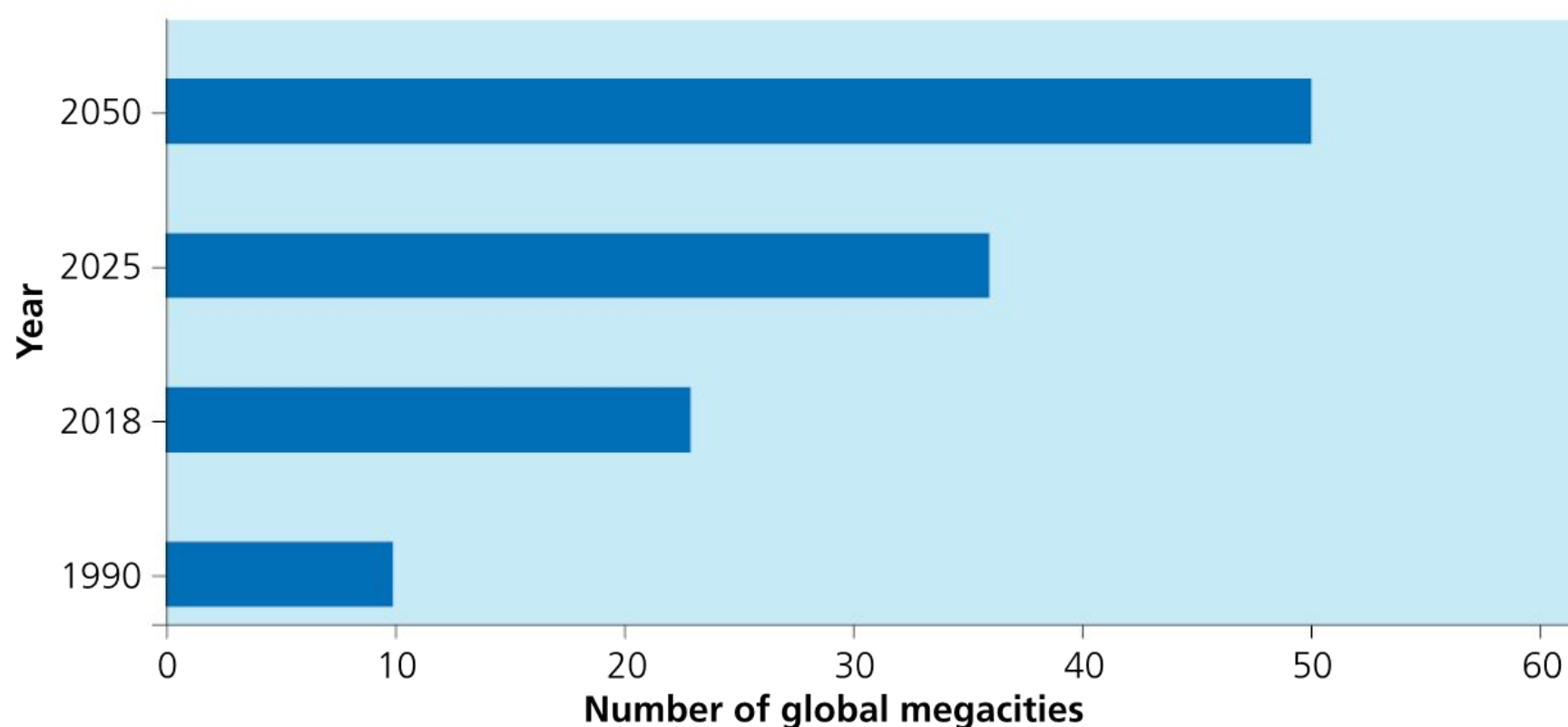
The UN has stated that almost 180,000 people move into cities every day.

1.5 billion
The number of people who live in 600 cities.

In 1990 there were only 10 megacities.
In 2025 there will be 36 megacities.
By 2015 there were approximately 50 megacities.

Most megacities will be in low-income countries.

75%
The percentage of the Indian population earning \$1 per day.



Top world megacities in 2018

1 Tokyo	13 Buenos Aires
2 Mumbai	14 Los Angeles
3 Mexico City	15 Karachi
4 New York	16 Cairo
5 Sao Paulo	17 Rio de Janeiro
6 Shanghai	18 Paris
7 Kolkata	19 Rhine-Ruhr
8 Delhi	20 Osaka
9 Beijing	21 Manila
10 Chongqing	22 Moscow
11 London	23 Istanbul
12 Dhaka	

Figure 3.25 An infographic showing the rise of the megacity

ACTIVITY: Reading infographics

ATL

■ Critical-thinking skills: Interpret data; Draw reasonable conclusions and generalizations

Analyse the infographic in Figure 3.25 in order to answer the following questions:

1 According to the UN, what is the total number of people living in cities today?

- How many megacities will there be by 2050?
- Which region in the world has the most megacities?
- What percentage of people in India lives on approximately \$1 per day?
- What are the values and limitations of using this infographic to show the rise of megacities?

Assessment opportunities

◆ In this activity you have practised skills that are assessed using Criterion D: Thinking critically.

What have governments and other social agents done to improve lives for people living in the cities?

REGENERATION IN LONDON: AN EXAMPLE OF URBAN REGENERATION FROM THE PAST

Regeneration is the redevelopment of an area. The old buildings are either modernized or knocked down and rebuilt. In many places, new jobs are introduced as more businesses are attracted to the area and so money is invested in improving the infrastructure. Many cities in **high-income countries (HICs)** have undergone this process.

One such city is London, where the area of Canary Wharf in East London has seen extensive regeneration. This area was once part of the busiest docks in the world, known as the West India docks, and employed thousands of people. Many who lived in the area worked at the docks. After the Second World War, many ships were too big for the existing docks, so new docks were developed nearer the mouth of the River Thames. As a result, people started to lose their jobs, there was very little investment in the area and many buildings, such as warehouses and terraced houses, started to deteriorate. By the 1970s, the area was completely derelict. There were no jobs and the infrastructure was inferior. Houses had only minimal amenities such as running water, sewage disposal and electricity. Many people left the area to look for jobs and a better quality of life.

In 1981, the government set up a redevelopment body, called the London Docklands Development Corporation (LDDC), to plan and regenerate the area. It relied on private finance to pay for new roads and to build a light railway, and businesses were given tax breaks to set up their offices in the area. The theory was that if you could get some businesses to invest in an area, this would attract other companies to invest in the area; this is called the multiplier effect.

The LDDC aimed to improve the following:

- Social conditions – creating new housing, new shops and new recreational facilities
- Economic conditions – creating new jobs and developing the transport links to the city of London
- Environmental conditions – improving the landscape by planting trees, creating parks and green spaces, and developing the derelict docks into new business areas

By the 2000s, the area was a significant financial hub for not just London, but the globe.

Around 20,000 houses were built or refurbished. Shops, water sports facilities and a university were all developed. The derelict land was cleared, and offices were established. Around 90,000 jobs were created by 2000, many in the financial sector, newspapers and media. Access to the area improved due to the building of the Docklands light railway, the Jubilee underground extension, better motorway links, and London City airport. Around 130 hectares of green space were created and 200,000 trees were planted.

However, many people who lived in the area did not have the skills required for the new jobs. Housing became too expensive for many locals. The shops too were mainly expensive, and out of the price range of many locals. Investment went into developing the offices rather than new hospitals, doctors, libraries or schools. Newcomers tended to have more money and not understand or mix with the local community; therefore, there was tension between the two communities. This process of newcomers moving into an area bringing in money is called **gentrification**.

ACTIVITY: Evaluating the successes and failures of urban regeneration – London Docklands

■ ATL

■ Critical-thinking skills: Evaluate evidence and arguments;
Draw reasonable conclusions and generalizations

■ Information literacy skills: Make connections between various sources of information

1 Copy and complete Table 3.1 using the information on page 63 and your own research. Search [London Docklands Development Corporation](#) and [London Museum Docklands](#)

Conditions	Successes	Failures
Social		
Economic		
Environmental		

■ **Table 3.1** Successes and failures of the regeneration of London Docklands

- 2 Evaluate the success of the regeneration of London Docklands.
- 3 What do you think was needed to make the regeneration more successful?
- 4 Investigate another urban regeneration scheme from the past:
 - Locate the city.
 - Research the background as to why the urban regeneration was needed.
 - Identify the main aims of the urban regeneration.
 - Suggest what was successful about the urban regeneration.
 - Suggest what was not successful about the urban regeneration.
 - Summarize how would you improve the scheme to make it more successful.

◆ Assessment opportunities

◆ In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding, Criterion B: Investigating, Criterion C: Communicating and Criterion D: Thinking critically.

Can urban areas ever be managed sustainably?

In the previous section, we saw how one urban regeneration scheme was not entirely successful. The major criticism of the London Docklands development scheme was that it did not provide jobs and facilities for the local people on lower wages. Urban development has now changed its focus to what is called sustainable urban development.

Sustainable urban development is a significant issue in the world today. The United Nations Sustainable Development Goal 11 reads:

'Making cities safe and sustainable means ensuring access to safe and affordable housing and upgrading slum settlements. It also involves investment in public transport, creating green public spaces, and improving urban planning and management in a way that is both participatory and inclusive.'

In the past, urban development has had mixed results: an area might improve physically, but not all local people benefit from the redevelopment. Affordable housing, green spaces, waste management and investment in public transport are some examples of ways in which development can be achieved sustainably and so improve life for the 60 per cent of the population living in urban areas today.

Figure 3.26 shows the three pillars or legs of sustainable development. Each pillar is of equal importance for sustainable development to succeed. Some urban developments in the past have not benefited all aspects of urban life, and therefore the redevelopment has been judged to have failed. In the twenty-first century, governments, civil society groups and intergovernmental groups all see the importance of sustainable development and resilience of cities.



■ **Figure 3.26** The three pillars/legs of sustainable development

THINK–PAIR–SHARE

Look at Figure 3.26. What examples can you **think** of for each pillar? Share your thoughts with your partner and the rest of the class. Do you all agree on the examples for each pillar? Are there any differences between your examples?

EXTENSION

Research into how the circular economy can help when designing sustainable and resilient cities.

Go to: www.ellenmacarthurfoundation.org/our-work/activities/circular-cities

Table 3.2 shows some examples of how cities around the world are developing methods to become more sustainable and resilient.

Bogotá, Colombia	Bogotá has developed an ultra-efficient Bus Rapid Transit system, that will be made up of hybrid and electric buses. It is also adding a new metro line and all taxis will be electric.
Copenhagen, Denmark	Copenhagen aims to be carbon neutral by 2025. This means the city will be able to absorb all the carbon that it emits. This is being done by using more green energy, building more energy-efficient buildings, reducing the number of cars, increasing bike lanes and having electric public transport. The number of plants around the city is also being increased, as they will absorb carbon.
Rio de Janeiro, Brazil	Rio has developed an urban revitalization plan, known as the Morar Carioca Program, which aims to make all of Rio's favelas formal; this means people living in the illegal housing will have an official address and legal rights to their house. The areas will have access to electricity, public transport, schools and doctors, and the physical environment is to be improved.
San Francisco, USA	Eleven years ago, 100 per cent of San Francisco's waste went to landfills. This has been reduced to 20 per cent by providing residents and commercial buildings with three bins: one for normal waste, one for recycling and one for compostable waste.

Table 3.2 Cities that are becoming more sustainable

The examples in Table 3.2 are just a few of many cities that are trying to develop to achieve a sustainable urban environment. Bringing all these methods together in one city would help to create the ideal sustainable city. However, it is not easy for development to be sustainable without political will.

Take action

ATL

■ Collaboration skills: Build consensus; Make fair and equitable decisions

- ! Work in pairs or in groups.
- ! Imagine you are a consultancy of urban developers who specialize in sustainable development solutions. Your local city government is inviting developers to tender their expertise in developing an area of the city.
- ! Research an urban issue that is found near you, or one that you are interested in elsewhere.
 - ◆ **State** what the urban issue is.
 - ◆ Brainstorm ways in which you could try to resolve the issue.
 - ◆ **Evaluate** which ways are more sustainable.
 - ◆ Prepare your pitch to be made to the city government. Make a **presentation** of your ideas. Include a map of the urban area that needs development, and the reasons why the urban area needs developing. **Describe** and **explain** how your project will develop the area for the better and how everyone, the environment and the economy will benefit.
 - ◆ Now **present** your plans to the city government (the rest of the class, or another class).
 - ◆ **Evaluate** all the projects presented by the class. Are they in keeping with the idea of sustainable urban development?

Assessment opportunities

- ◆ This activity can be assessed using Criterion B: Investigating.

Reflection

In this chapter, we have **identified** where and why the main urban growth has occurred since the mid-twentieth century. We have **explained** the causes and consequences of problems with urban growth in the past and **explored** new challenges facing sustainable urban management today. We have **taken action** to promote a sustainable urban development.

Use this table to reflect on your own learning in this chapter.					
Questions we asked	Answers we found	Any further questions now?			
Factual: What is urbanization? Where are all the megacities?					
Conceptual: Why has urbanization increased and what are the consequences? What have governments and other social agents done to improve lives for people living in the cities?					
Debatable: Can urban areas ever be managed sustainably?					
Approaches to learning you used in this chapter:	Description – what new skills did you learn?	How well did you master the skills?			
		Novice	Learner	Practitioner	Expert
Collaboration skills					
Communication skills					
Critical-thinking skills					
Information literacy skills					
Learner profile disposition	Reflect on the importance of being knowledgeable for your learning in this chapter.				
Knowledgeable					

4

How can we manage the interaction of water and land?



- Technology enables us to manage the systems and processes in which water and land interact; scientific understanding enables us to do so sustainably.

CONSIDER THESE QUESTIONS:

Factual: What are the main elements of river basins? How do rivers change downstream? What are the main elements of coastal change? What are the main landforms along rivers? What are the main coastal landforms?

Conceptual: How has human activity impacted on river and coastal regions?

Debatable: What level of human intervention is appropriate?

Now **share and compare** your thoughts and ideas with your partner, or with the whole class.

IN THIS CHAPTER, WE WILL ...

- Find out how rivers and coasts can change the landscape through natural processes.
- Explore how humans have tried to manage the processes of change in rivers and coasts.
- Take action by raising awareness of the impacts that flooding can have on many communities around the world.

These Approaches to Learning (ATL) skills will be useful ...

- Collaboration skills
- Communication skills
- Critical-thinking skills
- Information literacy skills

Assessment opportunities in this chapter:

- Criterion A: Knowing and understanding
- Criterion B: Investigating
- Criterion C: Communicating
- Criterion D: Thinking critically

We will reflect on this learner profile attribute ...

- Communicator – we will come to a decision on what to do based on evidence collected and will then try to persuade others to accept our decision.



■ **Figure 4.1** (a) Flooding in Bangladesh, (b) flood protection in the UK, (c) flood water rushing down a street in Austria

KEY WORDS

weathering
drainage

cycle
physical

WHAT MAKES YOU SAY THAT?



Look at the photos in Figure 4.2 and, in pairs, answer the following questions:

- What is going on in each photo?
- What do you see that makes you say that?

Share your answers with the rest of the class.

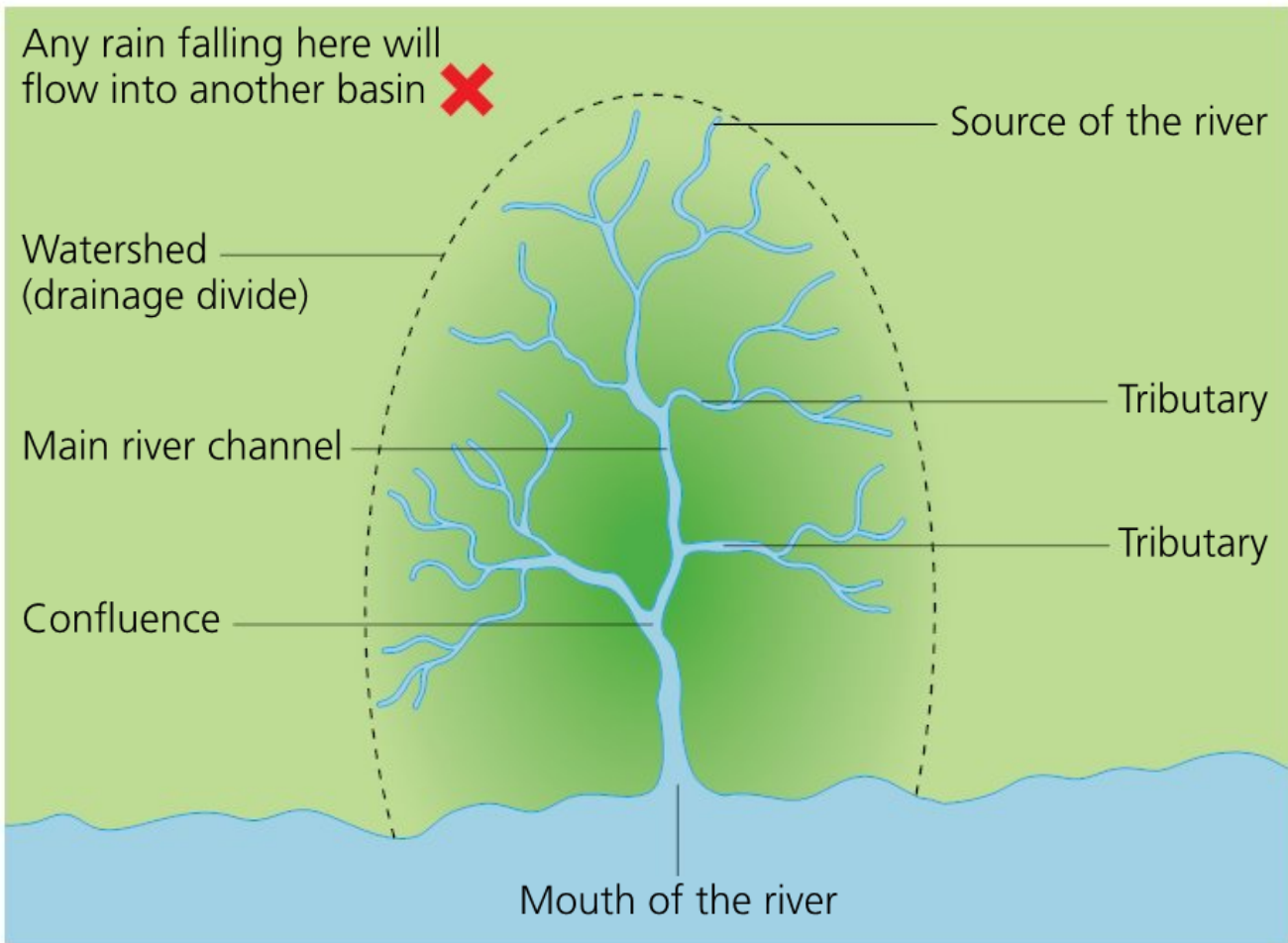
■ **Figure 4.2** (a) River floods, (b) dams, (c) a coastal area, (d) falling cliffs, (e) a waterfall, (f) the Twelve Apostles, Australia

What are the main elements of river basins? How do rivers change downstream?

THE DRAINAGE BASIN AND HYDROLOGICAL CYCLE

Rivers are an essential part of life. Many civilizations developed along major rivers, such as the Nile and the Euphrates. Rivers are part of a system called the water cycle or hydrological cycle. Rivers transport the water from one place to another in this system. You may know from your studies elsewhere (for example in *MYP Sciences by Concept 3*) that every system has the following elements: inputs, processes (such as flows and stores) and outputs. If we consider a river system in isolation, it can be seen as an open system (where the inputs and outputs can move to another system), since water can be taken to another drainage basin and so leave the particular river system under study. However, in reality, on a global scale, the hydrological cycle is a closed system (where the inputs, processes and outputs never leave the system), as the water never leaves the Earth's atmospheric system.

A drainage basin is an area where precipitation collects and then drains into a river or sea (see Figure 4.3).



■ **Figure 4.3** Diagram of a drainage basin

ACTIVITY: Drainage basin definitions

■ ATL

■ Communication skills: Take effective notes in class

Copy Table 4.1 and then use Figure 4.3 to add the key words.

Key word	Definition
	End of the river, where it meets the sea, lake or ocean
	Smaller river that follows into the main river channel
	The beginning of the river
	The boundary of the drainage basin
	Where two rivers meet

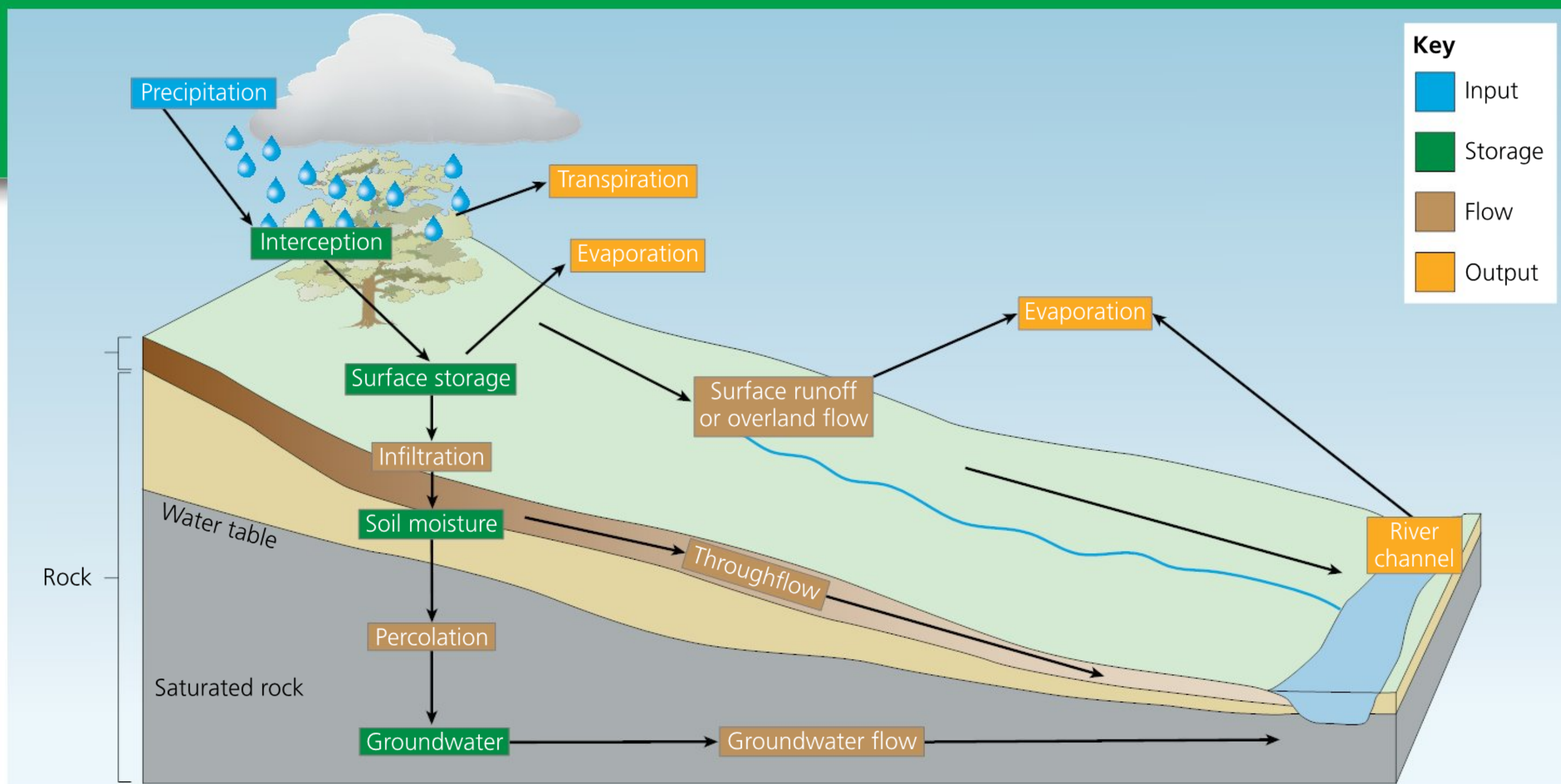
■ **Table 4.1** Drainage basin: key words and definitions

EXTENSION: EXPLORE FURTHER

Explore further how the shape and size of drainage basins can change the amount of water to flow down the drainage basin.

The drainage basin is part of the hydrological cycle. When the precipitation falls it will fall or flow into a drainage basin.

Figure 4.4 shows a labelled diagram of a hydrological cycle, within a drainage basin profile.



■ **Figure 4.4** The hydrological cycle and the drainage basin system

The hydrological cycle (see Figure 4.4) shows where the water flows (or is transferred) over and under the ground, where the water is stored in lakes, ponds and plants, and the inputs and outputs of the system. The input into the system comes in the form of precipitation (rain, sleet, hail and snow) from clouds that have developed due to condensation, where the water droplets that evaporated from the ground turned into ice crystals, mixed with dust in the atmosphere. Once the precipitation falls, it is either intercepted by plants or falls on the ground or straight into the water (into rivers or stores, such as lakes). Water can be stored in plants, or it flows through the plants (stem flow) into the ground. Once on the ground, the water then flows or infiltrates into and through the soil and then flows or percolates through the rocks in the ground, to the water table, where the rocks become saturated. Once the water is in the ground, it can either be stored as groundwater, in aquifers, or flows as groundwater flow either as a small underground river or through the rocks. This water can flow into another river, be taken up by wells or be stored, for example in a lake.



Annotating diagrams

In the activity below, you are adding explanations around a diagram. You should **summarize** what is happening at each point. For example, at 'Interception' you might add 'where plants stop the water from falling to the ground. The water is either stored in the plant, or transfers as stem flow.'

ACTIVITY: Annotate a hydrological cycle

■ ATL

■ Communication skills: Make effective summary notes for studying

Redraw Figure 4.4, including the **labels**. Read through the information on this page and, using this and your own knowledge, add details to each label.

THINK-PAIR-SHARE

Think: What other factors can change the amount of water that can flow or be stored in the hydrological cycle?

Discuss your ideas with a partner, and then share them with the class. Collect together and make notes of everybody's ideas, perhaps using a shared document online or another collaborative platform.

WHAT MAKES YOU SAY THAT?

Use Figure 4.5 to help you answer the following questions:

- What is going on in the photos? Describe what you see.
- What do you see that makes you say that? Can you suggest what types of processes are happening?

PROCESSES IN A RIVER

If you travel down a river you will see that it varies from one place to another. The flows look different, and many of the landforms around the river are different. This is due to the processes that occur in the river.

The first process that happens in the river is **erosion** – the wearing away of the land. There are four ways in which rivers can wear away the land:

- **Hydraulic action** – the power or energy of the water takes the **load** (rocks/stones in the river) down the channel
- **Attrition** – when the rocks/stones knock into each other or into the bed and side of the channel, they are broken down to be carried away
- **Abrasion** or **corrasion** – fine materials, like sand, rub against the bed or banks of the river, rather like sandpaper rubbing and then wearing away the river
- **Corrosion** – the rock dissolves and is carried away. (The extent to which this happens will depend on the rock type and the **pH** of the water.)

The second process is **transportation** – this is how the eroded material/load is taken downstream. Again, there are a number of different ways in which this process occurs:

- **Traction** – when a large load is rolled downstream by the energy of the water
- **Saltation** – when a smaller load is carried by the water, but it is small enough for it to jump up and down the river
- **Suspension** – when fine sand-like material floats in the river (this makes the water look darker as you go downstream)
- **Solution** – the dissolved load is transported down as a solution, like sugar that has been dissolved in water.

The third process in the river is **deposition**. This is when the river does not have enough energy to transport the load anymore and therefore it is left, dumped or deposited.

The exact nature of each process depends on many variables, including the position along the course of the river, how fast the river is flowing, the size of the load, the pH of the river, the rock type of the area and the **discharge** of the river (the amount flowing in the river).

HOW A RIVER CHANGES DOWNSTREAM: THE BRADSHAW MODEL



■ **Figure 4.5** Different sections of a river: (a) upper course, (b) middle course, (c) lower course

ACTIVITY: The river processes

■ ATL

- Communication skills: Make effective summary notes for studying

Annotate diagrams to **show** how the river processes of erosion and transportation work.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion C: Communicating.

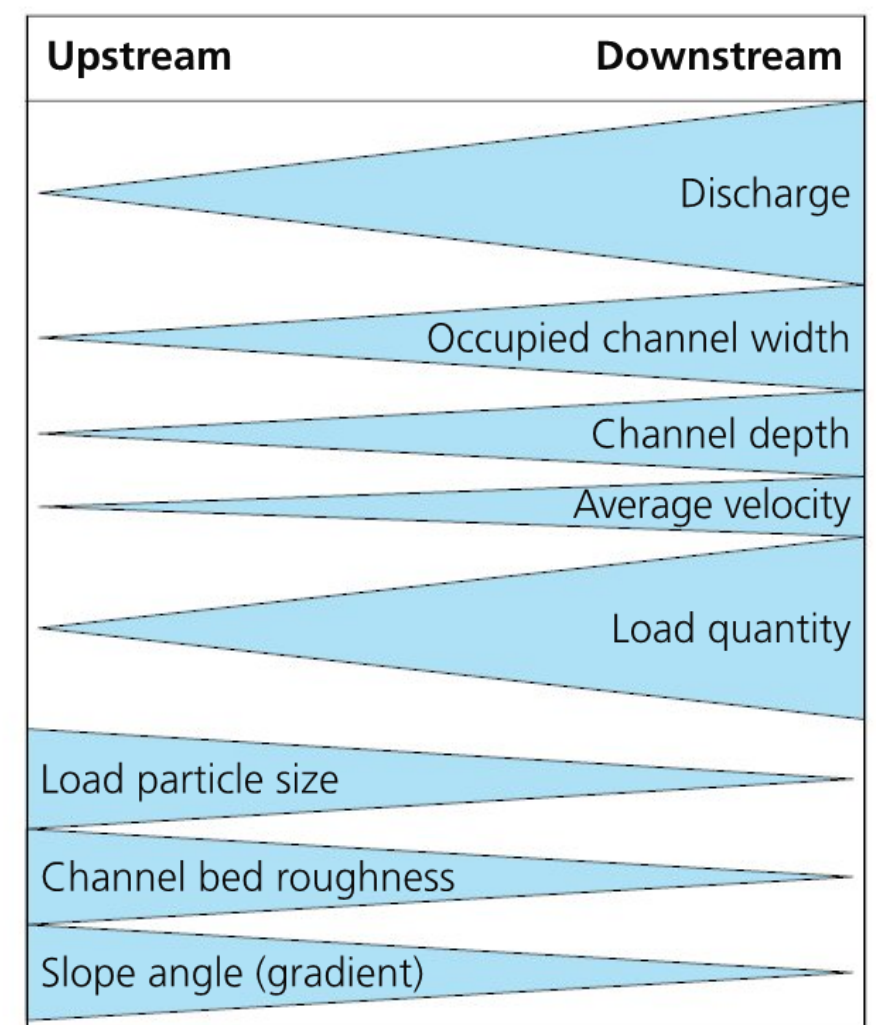
The river flows from the **source** to the **mouth**. At each stage of the river course, the river changes due to the natural processes of erosion, transportation and deposition. The length of a river course is known as the long profile. The long profile shows how the river gradient changes from the highland, or upper area of the source, to the lowland areas of the middle and the lower course towards the mouth (see Figure 4.6).

At each stage, there are changes in the river. As the photos in Figure 4.5 show, the river becomes wider, deeper and has more water flowing, known as discharge. Like all sciences, geography uses models to represent complex processes in a simplified form. Geographers use the Bradshaw model (see Figure 4.7) to describe how and why rivers change downstream.

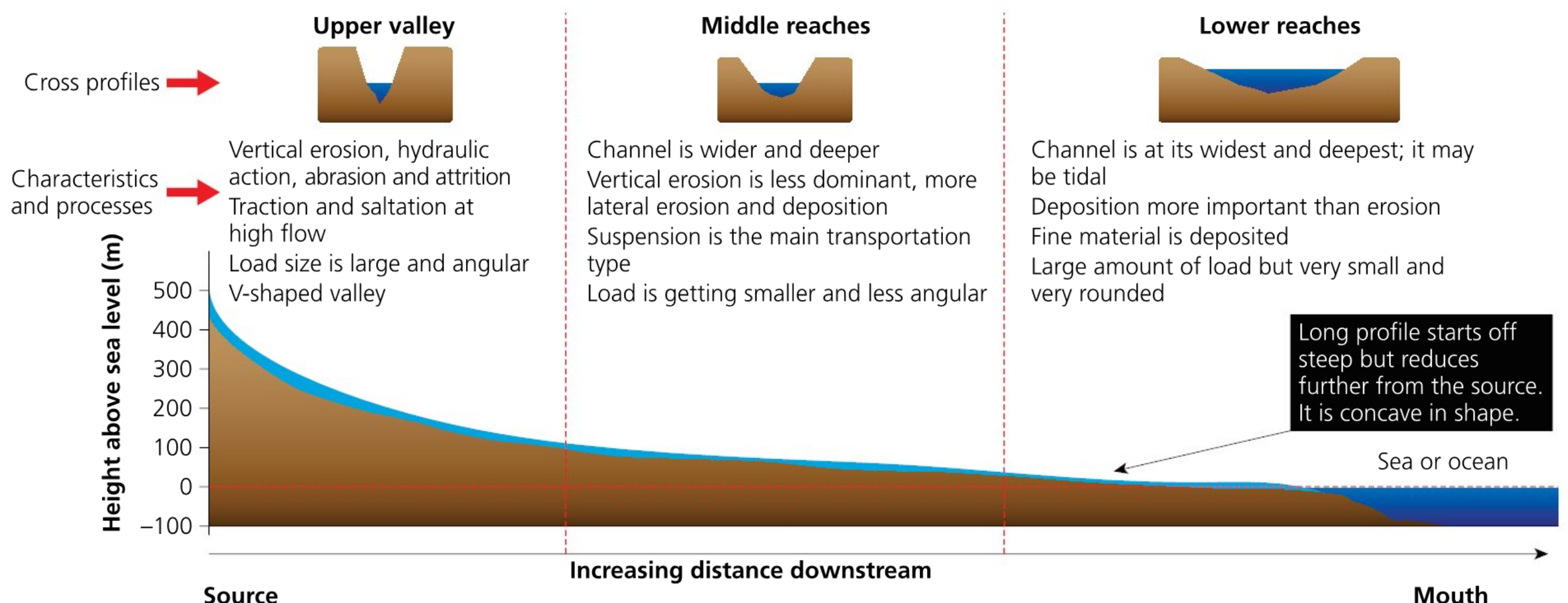
The Bradshaw model shows how the river channel changes from the source to the mouth. The reasons for these changes are the natural processes of erosion and transportation. As the water flows downstream, more water enters the main channel from **tributaries** (see Figure 4.3). As there is more water, there is more flow and therefore more energy. With an increase in energy, or erosional power, the river can change shape, by getting wider and deeper. This also means that the load gets smaller in size due to the power of erosion (in the form of attrition).

DISCUSS

Study the Bradshaw model of how rivers change downstream (Figure 4.7). **Describe** how each variable changes from the source to the mouth. **Explain** why each variable changes from the source to the mouth.



■ **Figure 4.7** The Bradshaw model



■ **Figure 4.6** A river's long profile

ACTIVITY: Fieldwork – to what extent does the Bradshaw model fit a real river?

■ ATL

■ Communication skills: Write for different purposes; Organize and depict information logically

■ Information literacy skills: Collect, record and verify data; Process data and report results

You are going to **design** a piece of geography fieldwork to **investigate to what extent** the Bradshaw model fits real rivers.

Your aim is to see how three variables from the Bradshaw model change downstream.

To complete the investigation, you need to do the following:

- 1 Write a title for your investigation in the form of an inquiry question. Make sure that you **state** the variables you will measure in order to answer the question.
- 2 Write a hypothesis for each of the three Bradshaw model variables that you will use in your investigation; for example: The river will increase in width as it flows from source to mouth.
- 3 **Design** your methods of collecting the data. For example, you could choose ten sites along the river from near the source and then downstream. Then at each site you could **measure** the width by pulling a tape measure straight across the river.
- 4 Show ways that would be used to display the data you have collected; for example, to show how the width changes downstream, you could draw a line to represent the width at each site.
- 5 **Analyse** the data. What do the data suggest for each hypothesis?

Hint

You could use scatter graphs (see page 13) to see if there is a correlation between two variables.

Do your data fit with the hypothesis? What data show this, and is there any part of the data that does not fit?

- 6 Write a conclusion for each of your hypotheses. In your conclusion, make sure that you **describe** and **explain** how the data relate to the hypothesis. **Suggest** whether or not your investigation supports the Bradshaw model.
- 7 **Evaluate** your investigation. **To what extent** was it valid?

Most river studies fieldwork is now done by organized companies or by experienced teachers who know the river extremely well. Table 4.2 gives some data you might use if you are not able to carry out your own data collection.

Site	Width (cm)	Depth (cm)	Average load/ sediment size (cm)
1	30	10	20
2	35	15	25
3	55	20	18
4	65	22	18
5	100	30	18
6	75	25	20
7	100	30	15
8	150	33	10
9	200	40	15
10	210	45	10
11	215	45	10
12	275	50	7
13	350	82	5
14	375	85	3
15	400	100	5

■ **Table 4.2** Data for a river profile

◆ Assessment opportunities

◆ In this activity you have practised skills that are assessed using Criterion B: Investigating, Criterion C: Communicating and Criterion D: Thinking critically.

What are the main elements of coastal change?

Like rivers, coastal areas change due to processes within the hydrological cycle. The changes in coastal areas are caused by the sea, or ocean. Waves form when the wind blows over the surface of the sea. The size of the waves depends on the energy of the wind, which depends in part on its fetch (the length of water over which it has blown), how long the wind has been blowing and how far the wave has travelled. As with rivers, the more energy there is, the more erosion and transportation power there is.

DISCUSS

There are two types of waves: destructive and constructive. Which wave do you think will link to the process of erosion and which to the process of deposition?

As the name suggests, **destructive waves** destroy or erode the land, in most cases a beach. The water that comes up on the beach is called the **swash**, and, in a destructive wave, is weaker than the **backwash** (the water that leaves the beach). This means that **sediment** from the beach is taken away and transported somewhere else. Destructive waves tend to be higher and closer together than **constructive waves**, due to the high winds.

Constructive waves are the opposite: the swash is stronger than the backwash and sediment is deposited on to the beach. These waves tend to be lower and further apart, due to lighter winds.

Erosional processes in coastal areas are the same as those for rivers: hydraulic action, attrition, abrasion or corrasion, and corrosion.

ACTIVITY: Wave hello, wave goodbye

■ ATL

- Communication skills: Take effective notes in class
- Critical-thinking skills: Draw reasonable conclusions and generalizations

- 1 **Draw two diagrams showing a destructive wave in action on a beach and a constructive wave in action on a beach. Add the following labels to your diagrams:**
 - Weak swash
 - Strong backwash
 - Sediment is built up
 - Waves are higher and closer together
 - Weak backwash
 - Strong swash
 - Sediment is removed
 - Waves are lower and further apart
- 2 **Suggest which wave type will have a longer fetch and higher wind speed. Explain your answer.**
- 3 **Suggest which beach will cause more erosion.**
- 4 **Suggest the issues you think people living near a beach with destructive waves may have.**

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding.

The four processes work in the same way as in rivers. However, there are further processes working in coastal areas, such as weathering and mass movement. Weathering is the breaking down of the rock. This occurs as a result of water getting into the rock, freezing at night and expanding. Over time, this puts pressure on the rock and it will eventually break up. Plant roots and chemicals can also break up the rock.



SEE-THINK-WONDER

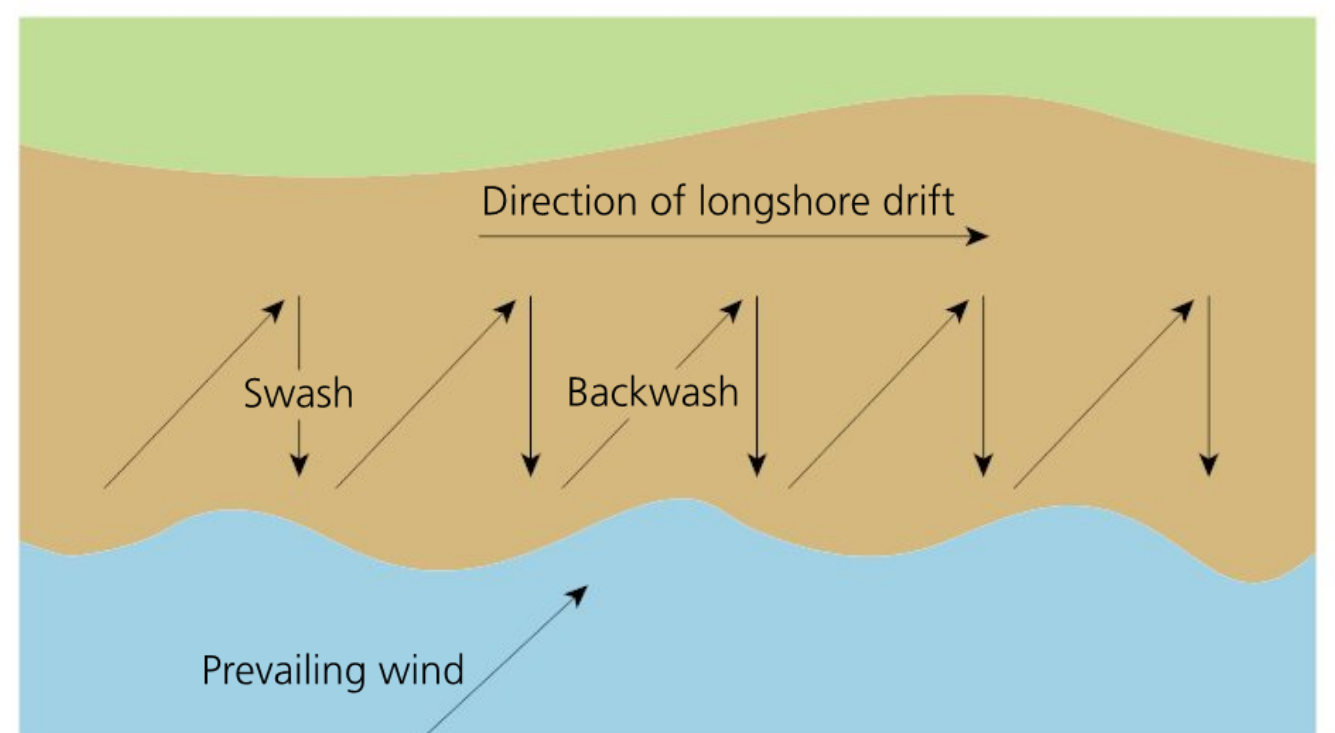
Look at the photos in Figure 4.8. What do you see? What does this make you think is happening? What does this make you wonder?



■ **Figure 4.8 (a)** Physical and biological weathering along the coast and **(b)** coastal mass movement

EROSION AND TRANSPORTATION ALONG THE COASTS

As in rivers, there are four ways in which sediment can be transported from one place to another at the coast: traction, saltation, suspension and solution. The sediment is transported by the waves along the coast as part of a process called **longshore drift**. The prevailing (dominant) wind blows the waves at an angle to the beach. The swash moves the sediment up the beach at an angle, and the backwash removes the sediment. This process continues until the sediment is deposited elsewhere. As in rivers, this occurs when the energy of the water is not sufficient to carry the sediment. Constructive waves may also deposit material. Sediment may be deposited in shallow water, where there is little energy to carry the sediment; when there is little or no wind to move the wave and in sheltered areas like bays, where there is little wind.



■ **Figure 4.9** Longshore drift

What are the main landforms along rivers?

As we have seen, rivers change downstream because of the natural processes, such as erosion, transportation and deposition. These processes also work together to make different landforms along the river.

In the upper section of a river, more erosional processes take place, due to the **gradient** being steeper; towards the middle and lower sections, the depositional process starts to become more dominant.



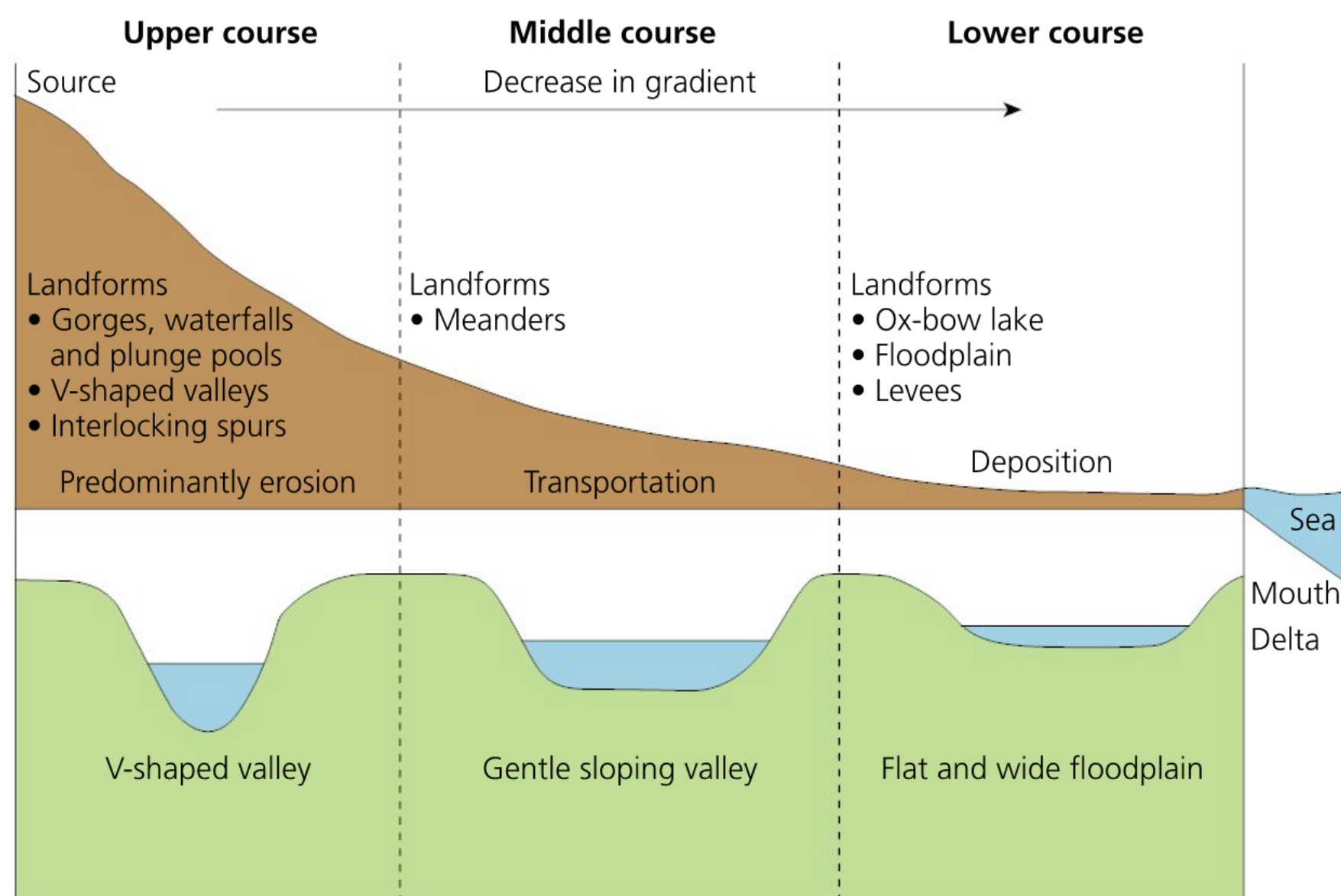
■ **Figure 4.11 (a)** V-shaped valley



■ **Figure 4.11 (b)** Waterfall



■ **Figure 4.11 (c)** Meanders



■ **Figure 4.10** Position of landforms along a river



■ **Figure 4.11 (d)** Ox-bow lake



■ **Figure 4.11 (e)** Delta

ACTIVITY: The view from a river

■ ATL

■ Communication skills: Make effective summary notes for studying

Copy Table 4.3 and add the information from Figures 4.10 and 4.11 (a)–(e) to **summarize** the formation of the main river landforms.

Course of the river	Landforms and how they are formed
Upper course	V-shaped valleys and interlocking spurs: Waterfalls and gorges:
Middle course	Meanders:
Lower course	Ox-bow lakes: Floodplains: Deltas:

■ **Table 4.3** Formation of the main river landforms



Recognising landforms using a map



■ **Figure 4.12** An OS map of a river's middle course

Identify the following on Figure 4.12 and give a four-figure grid reference for each:

- Meander
- A potential ox-bow lake
- Confluence

Hint

Remember when giving a four-figure grid reference to use the numbers along the bottom and then the numbers along the side: Along the corridor and up the stairs.

What are the main coastal landforms?



■ **Figure 4.13** (a) Stacks and an arch, (b) a wave-cut platform, (c) a bay, (d) a spit and lagoon

THINK-PAIR-SHARE

Look at the photos of coastal landforms in Figure 4.13. Think and then share your ideas about how these landforms were created. What processes do you think were involved in creating them?

All coastal landforms are created due to the processes of erosion and deposition. The rate of change depends on the energy of the waves and the type of rock. Bays and headlands are formed due to differences in rock type, the softer rock eroding more quickly than the harder rock. Hydraulic action cuts the softer rock under a cliff to produce a wave-cut platform. Spits are formed when sediment is deposited due to a change of direction of the coastline, and the area is sheltered from the wind, so there is very little energy for the sediment to be transported by the wave.

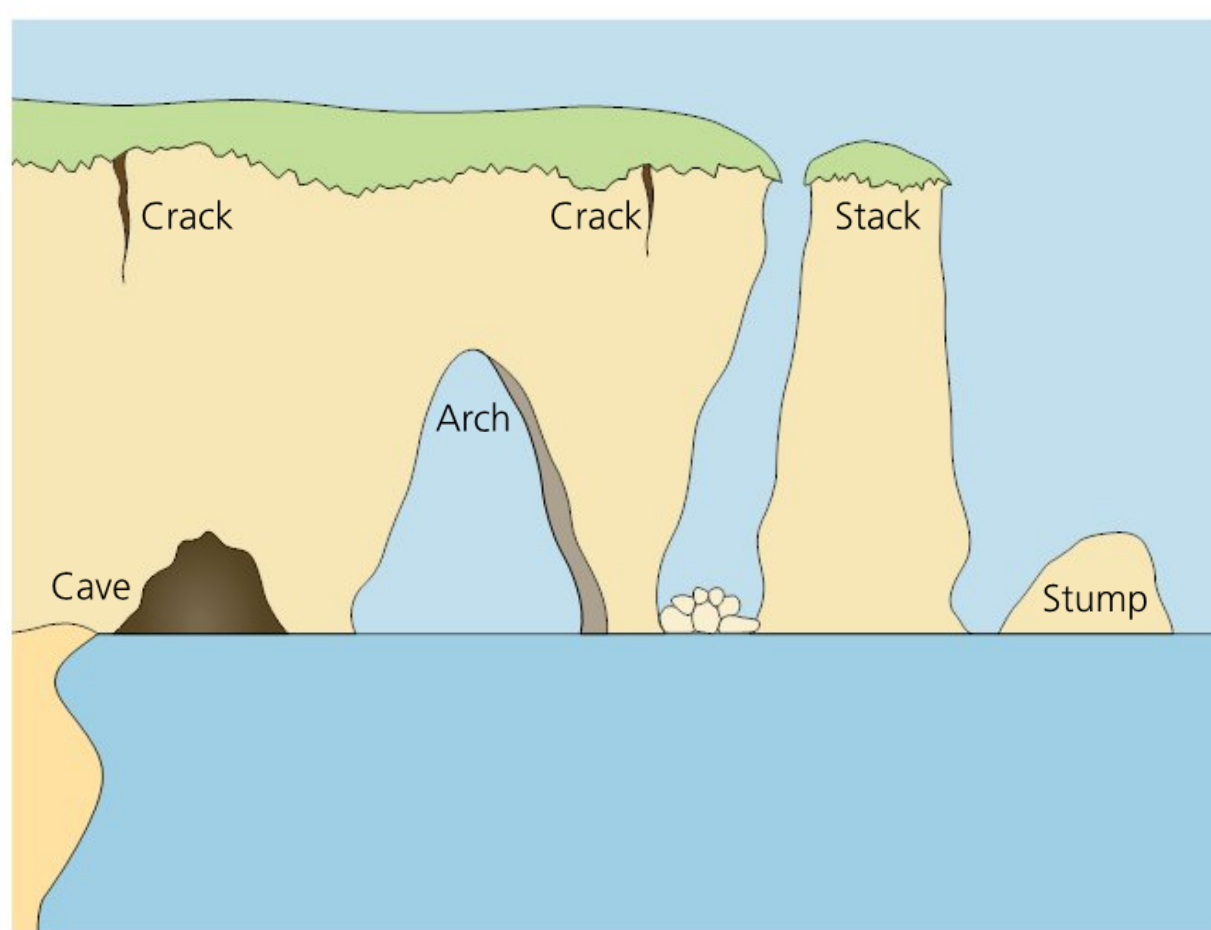
Many coastline landforms are popular with tourists. In the UK, for example, people visit Swanage Bay, Chesil Beach and Old Harry's rock on the Dorset coastline.

ACTIVITY: Annotate diagrams

■ ATL

- Communication skills: Make effective summary notes for studying

Copy and **annotate** the diagram in Figure 4.14 to help **explain** the processes that create this coastal landform.



■ **Figure 4.14** Coastal landforms

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding.

ACTIVITY: Investigate the landforms of a coastal area

■ ATL

- Communication skills: Use a variety of media to communicate with a range of audiences

You are going to prepare an interactive map, a rolling PowerPoint (one on a loop) or a diorama (a map that shows a wide area) with annotations to inform people about the processes that occur along your chosen coastline.

You should include the following:

- A map of the area covering the three main sites to visit
- Images of the landforms
- For each landform, a suitable diagram – either a **labelled diagram** with explanations underneath, or an annotated diagram with the explanations surrounding the diagram (you can use both methods in your **presentation**)
- A bibliography, using your school's preferred convention

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding, Criterion B: Investigating and Criterion C: Communicating.

How has human activity impacted on river and coastal regions?

We have seen how natural processes affect the surroundings in a river system. However, almost all rivers have also been changed in some way by humans, perhaps through building, farming or deforesting next to the river, building a dam or changing the course of the river by straightening or even redirecting the river course entirely. All these and many other human activities change the river system and processes, therefore changing the landforms and how the river will flow.

Over half the world's population now lives in urban areas, and most of these are next to rivers. The process of urbanization (see Chapter 3) has a significant effect on the nature of rivers, and can sometimes have severe consequences.

Plants have an important role in intercepting precipitation, and soil slows water as it moves towards a river. However, if there is no interception by plants and there is concrete instead of soil, water runs into the river more quickly, which can mean too much water in the river, and can lead to floods. Farming can have a similar effect, as rain runs quickly off soil that is exposed by ploughing.

River straightening and dam building can control the discharge of a river. Dam building can reduce the amount of water flow; if there is a possibility of flooding, sluices in the dam can be closed so that some water will remain behind in the reservoir. River straightening can also reduce flooding by letting water flow quickly rather than allowing it to build up and flood over the banks of the river.

Flooding occurs when there is too much water in the river channel. This can happen very quickly, causing flash floods, or it can happen over a long period of time, causing prolonged flooding, which can last for weeks or even months.

GENERATE–SORT–CONNECT–ELABORATE

Research images of rivers with human activities alongside them: farming, urban area, river straightening, dam and reservoir, bridge, river being redirected, **deforestation** in upper course, building on floodplain, embankments (channelization), river divided into smaller rivers near urban area, sewage plant, factory, docks near a delta.

For each human activity:

- **Generate a list of ideas and thoughts about the impact of the activity on the river's processes.**
- **Sort your ideas according to whether you think they are positive or negative.**
- **Connect the activities that are seen as having positive/negative impacts on the river's processes by writing a short sentence on how the activities are connected.**
- **Elaborate on this by thinking about how these activities can impact on people and the wildlife living near the river.**

At the end of this Visible Thinking Routine you should have a good understanding of how human activities along a river can have an impact on the river, people and wildlife, in either a positive or a negative way. Can some activities be seen as both positive and negative? Do all human activities along a river mean there will always be a negative impact?

THE CAUSES OF FLOODING

The leading causes of flooding can be divided into natural and human causes:

Natural causes

- Prolonged or heavy rainfall – when a lot of rain falls for a long time, there will be more water collected in the drainage basin and flowing into the river. If there is heavy rain for a short period, flooding can be very quick (flash flooding).
- Rock type, or geology – some rocks are more permeable than others. Permeable rocks allow more water to percolate through, as there are more pores or cracks. When a rock is impermeable, the water will run off into the river more quickly.
- Gradient/relief of the land – when the land is steep, it is easier and quicker for the water to get to the river, and not infiltrate into the soil; therefore, the chances of flooding increase.
- Type of vegetation – vegetation intercepts the rain falling to the ground, but if there is little or no vegetation, then the water will drain straight into the river.
- Weather – when it is hot and sunny for a long period of time, the soil becomes dry and like tarmac. Then when there is a storm, the rain does not seep into the soil but runs off straight into the river and can cause flash floods.

Human causes

- Deforestation
- Lack of vegetation
- Urbanization
- Changing the river channel course – people have tried to make it easy to navigate rivers by straightening them, or by making the river course shorter by cutting off the **meanders**. This results in less river for the water to flow in and therefore flooding can occur.

ACTIVITY: Causes of flooding

■ ATL

- Communication skills: Take effective notes in class

Review the hydrological cycle and drainage basin at the beginning of the chapter. **Explain** how deforestation, lack of vegetation and urbanization can cause flooding. You could organize your explanation in the form of a table.

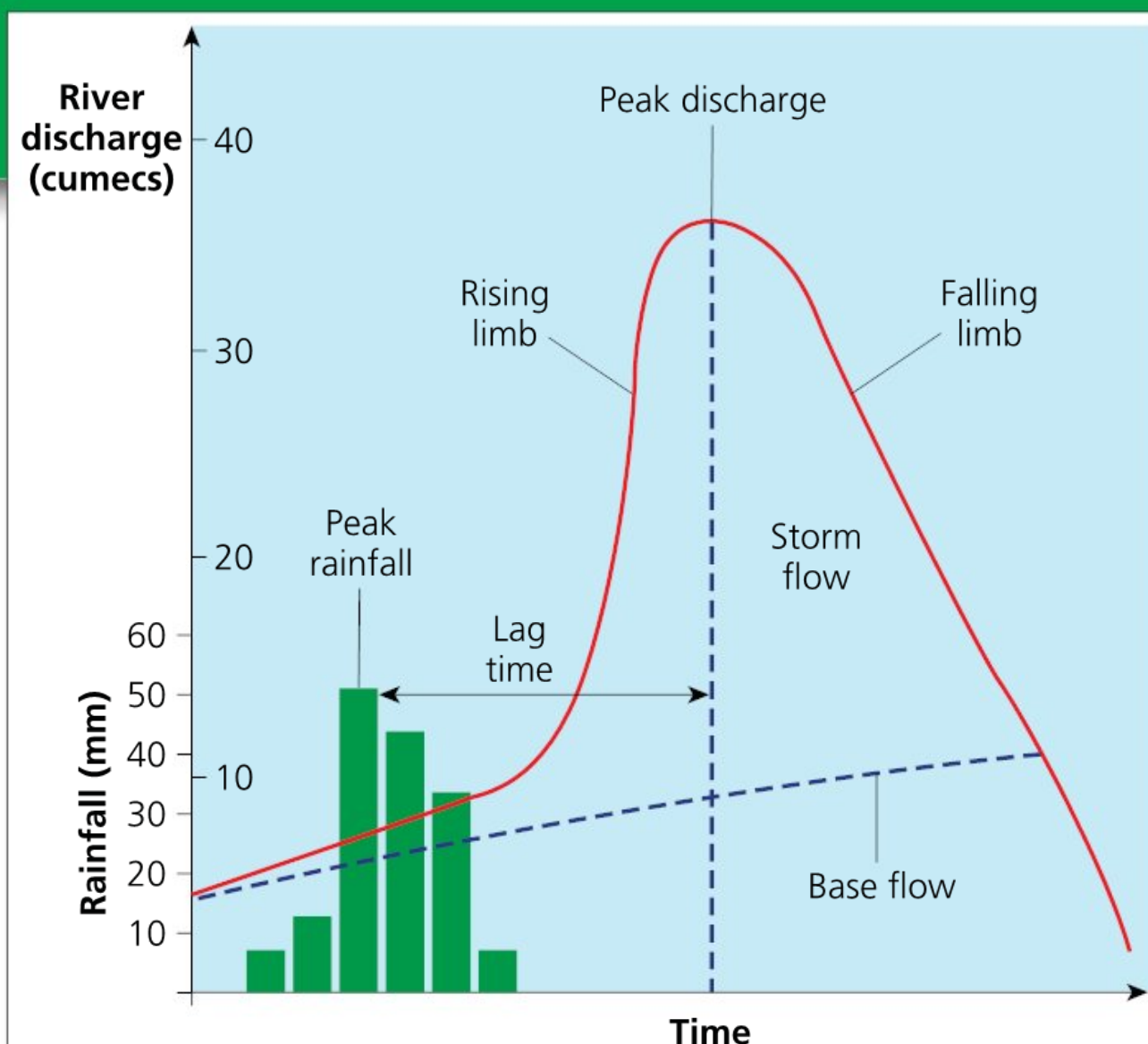
◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding.

HYDROGRAPHS

Hydrographs are used to show how long a river takes to flood. A hydrograph looks at the rainfall and the discharge, which is measured as the amount of water that flows past a given point in the river in cumecs, or m³/sec.

Figure 4.15 shows a typical hydrograph. The steepness of the **rising limb** shows how quickly the discharge increases. The **lag time** is the time between peak precipitation and peak discharge. Therefore, a short lag time means water has got into the river quickly and it is more likely to flood. The opposite will happen when it takes a long time for the water to enter the river, with a long lag time and a smaller rising limb.

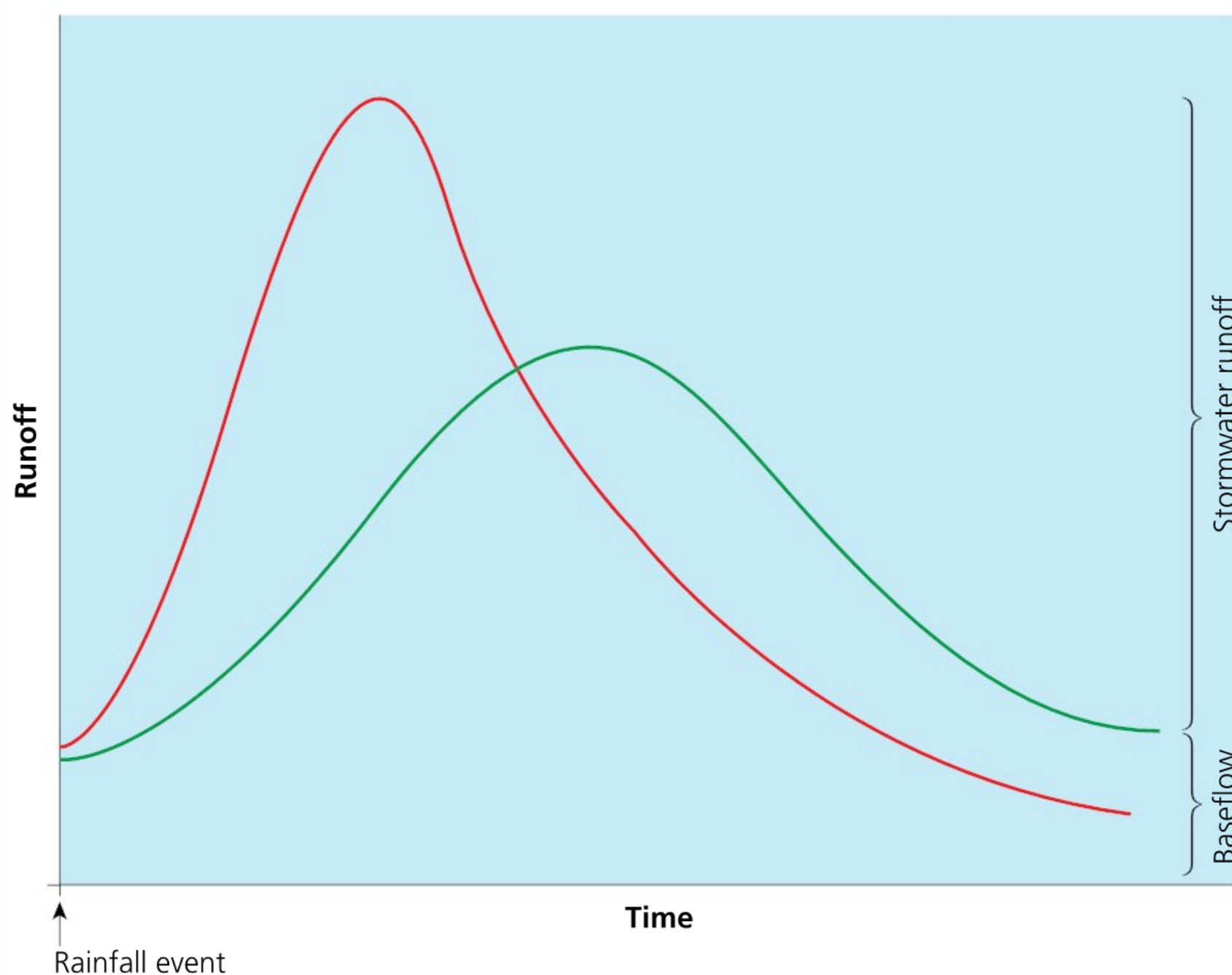


■ **Figure 4.15** A typical hydrograph

ACTIVITY: Analysing hydrographs

■ ATL

- Critical-thinking skills: Interpret data; Draw reasonable conclusions and generalizations



■ **Figure 4.16** Two hydrographs

Study Figure 4.16.

Describe the two hydrographs.

Explain why the two hydrographs are different.

State which hydrograph is more likely to cause major flooding for people living in the area. Give reasons for your answer.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding.

CIRCLE OF VIEWPOINTS

In this activity, you will **evaluate** the different methods for reducing flooding.

In groups of four, each person should take on a different perspective:

- **Person who lives near the flooded area**
- **Farmer who wants to protect their land near the flooded area**
- **Environmentalist who wants to keep the river natural**

FLOOD PREVENTION

Various flood prevention methods have been developed over time, some using up-to-date technology, some less expensive methods using little technology. Here, we will be looking at the difference between hard engineering or technology – the expensive, large ways of protecting the river; and the soft engineering strategies, which tend to be inexpensive and more sustainable methods of protecting the river from flooding.

■ **Table 4.4** The main hard and soft methods for protecting a river

Name and description	Advantages	Disadvantages
Soft engineering	Can you think of any others?	Can you think of any others?
Reforestation/ afforestation: Replanting forests or planting new forest to reduce surface runoff and increase interception.	Less water gets to the river, reducing the discharge. The ecosystem of the area is protected. Very effective method for reducing discharge, while keeping the environment protected.	Difficult to plant forests in urban areas. Takes time for the flood prevention to be successful.
Floodplain zoning: The urban land use areas are zoned to reduce the flood risk impact.	Buildings and land that is expensive to insure are located further away from the river. Areas next to the river are able to flood, as they are zoned to be green places, farmland. Less claims for insurance, as businesses and houses are not flooded.	It is not always possible to develop old urban areas into new zones. Some people might not approve of the zone methods. Can take time to zone the area next to the river. It does not stop the flood.
Flood warning and preparation (mitigation): People are warned about possible flooding and therefore can prepare for it. Warnings can be given via newspapers, TV, radio, the internet.	People know when to protect their houses with methods such as sand bags and when to leave. People can have their houses and businesses insured.	Not all people have access to the methods of warning. Not all insurance companies will insure people who have buildings near a known flooded area. Some flash floods can be too quick for the warning systems to be effective. It does not stop the flood.

- River engineer who wants to stop the flooding but knows that they must protect the environment around the river

Brainstorm a **list** of different methods (both hard and soft) for protecting a river and then use this outline to **explore** each one:

- *I am thinking of ... [the topic] ... from the point of view of ... [the viewpoint you've chosen]*

- *I think ... [describe the topic from your viewpoint; be an actor – take on the character of your viewpoint]*
- *A question I have from this viewpoint is ... [ask a question from this viewpoint]*

As a group, **discuss** what each person would want to do to protect the land from flooding.

What do you think they should do? Would you use hard engineering or soft engineering?

Name and description	Advantages	Disadvantages
Hard engineering	Can you think of any others?	Can you think of any others?
Dams: The dam traps water behind a large wall. The amount of water flowing downstream is controlled.	Can control the discharge of the river. Provides hydroelectric power. Reservoir can provide fishing and be a tourist attraction.	Very expensive to build. Sediment that is usually washed downstream can be trapped behind the dam and therefore the reservoir holds less water. Sediment that would fertilize the land further downstream does not and therefore the farmland loses its natural source of nutrients. People are forced to move due to the flooding of land for the reservoir.
Flood relief channels: Some of the water is directed away from the main river channel and released back further downstream, or into another river or lake.	Reduces the risk of flooding.	The flood relief channel might flood. Expensive to build. Need land next to the river to build, therefore difficult to build in urban areas.
Embankments: Holding back the river from the banks, either with concrete or wooden walls. Usually the banks are raised as well.	More water can pass through. The banks will not erode, therefore the land next to the river is protected. You only need to build the embankment once and then maintain it, therefore it is relative cheap.	The velocity of the water can increase, therefore the risk of flooding increases further downstream. It looks unnatural, which some might not like.
River straightening/channelization and dredging: Straightening the river, or channelization, means that the water can pass through quicker due to the lack of friction, reducing the risk of flooding. Dredging the bottom of the river for sediment means the river is deeper and therefore can hold more water.	Water will go through the river quickly, therefore reducing the risk of flooding. The river channel can hold more water. Dredging is an easy method to reduce flooding in built up areas.	The velocity of the water can increase, therefore the risk of flooding increases further downstream. As sediment builds up over time, dredging needs to be done frequently. Dredging can change the ecosystem in the river.
Levees: Land is built up to make the bank side higher.	The river banks are higher and therefore when the river floods the areas next to the river are protected. Relatively cheap as soil can be used to make the levees. Can be used as walking and cycle paths for tourism.	Levees need to be maintained frequently. If the levees break, the consequences can be devastating.

What level of human intervention is appropriate?

As we have seen for rivers, coastal areas may also be protected using both hard and soft engineering approaches.



■ **Figure 4.17** Examples of hard and soft engineering used in coastal protection: **(a)** a seawall, **(b)** groynes, **(c)** beach nourishment, **(d)** rock armour, **(e)** dune nourishment and protection, **(f)** gabions, **(g)** beach reprofiling



ACTIVITY: Coastal protection

■ ATL

■ Communication skills: Making effective notes

Copy and complete Table 4.5. Using the photos in Figure 4.17 and your own research, **describe** and **explain** how each type of coastal protection method works.

Method	How it works
Seawall	
Groynes	
Beach nourishment	
Rock armour	
Dune nourishment and protection	
Gabions	
Beach reprofiling	

■ **Table 4.5** Different coastal protection methods

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding.

ACTIVITY: Going in hard or taking it softly?

■ ATL

- Collaboration skills: Listen actively to other perspectives and ideas; Encourage others to contribute; Build consensus

1 Using the photos in Figure 4.17, create a table similar to Table 4.6 below. Use your table to classify different methods in terms of hard and soft engineering.

Hint

Hard engineering methods are artificial and they try to control the natural processes of erosion, transportation and deposition.

2 In pairs or groups, research and evaluate how successful the different methods might be in terms of protection, and also in terms of their **sustainability** for the surrounding area. Think in terms of the area they are protecting, but also areas further down the coastline. An example has been done for you below.

Method	Why is it built?	Hard or soft engineering and reasons why	Evaluation
Groynes	It is used to stop beach material from eroding away, so the beach does not get depleted.	Hard engineering. It is expensive to build and maintain. It is artificial and tries to control the natural processes.	Very useful in stopping the beach from being depleted. However, it stops sediment from transporting down the coast, so other beaches are starved and lose sediment, making that area exposed to erosion.

■ Table 4.6 Hard and soft engineering – evaluation table

3 Evaluate the extent to which hard engineering causes more problems in the future than soft engineering.

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion D: Thinking critically.

! Take action

■ ATL

- Information literacy skills: Access information to be informed and inform others

- ! In some regions around the world, flooding has caused thousands of deaths. However, many areas cannot afford to invest in the hard engineering that some countries, like the Netherlands, have used to address this problem. When an area is flooded, many people find themselves without food, shelter or fresh running water. Find out what charities, whether local or international, do to help people who have suffered from flooding.
- ! If there has been a recent flood, then take action by promoting the charities you have found. Maybe the school community could raise money or, if the issue is local, help out the flood victims.

Reflection

In this chapter, we have **explained** the many ways in which the natural processes and systems of water can change the landscape and the many ways in which humans have tried to change or even halt these processes. We have **identified** and **evaluated** the different types of technology that have been used to protect the land from water. We have **taken action** to support those who cannot afford such protective measures.

Use this table to reflect on your own learning in this chapter.					
Questions we asked	Answers we found	Any further questions now?			
Factual: What are the main elements of river basins? How do rivers change downstream? What are the main elements of coastal change? What are the main landforms along rivers? What are the main coastal landforms?					
Conceptual: How has human activity impacted on river and coastal regions?					
Debatable: What level of human intervention is appropriate?					
Approaches to learning you used in this chapter:	Description – what new skills did you learn?	How well did you master the skills?			
		Novice	Learner	Practitioner	Expert
Collaboration skills					
Communication skills					
Critical-thinking skills					
Information literacy skills					
Learner profile disposition	Reflect on the importance of being a good communicator for your learning in this chapter.				
Communicator					

5

How sustainable is global economic growth?



Individual decisions about consumption can have global impacts; we need to act to change production for a more sustainable world.

CONSIDER THESE QUESTIONS:

Factual: What is the world pattern of resource production and consumption? How is the supply chain of products organized? What are the environmental impacts of global resource production and consumption? How can sustainable levels of resource extraction, production and consumption be achieved?

Conceptual: How do global interactions influence the production and consumption of resources? How is the circular economy making production systems more sustainable?

Debatable: Are global consumption levels sustainable? How can individual consumers make a difference?

Now **share and compare** your thoughts and ideas with your partner, or with the whole class.



■ **Figure 5.1** Palm oil industry in Malaysia

IN THIS CHAPTER, WE WILL ...

- **Find out** what the global pattern of resource production and consumption is and how the supply chain of manufactured products is organized by multinationals.
- **Explore** the different environmental impacts of global production and consumption of resources on major world ecosystems; the ecological footprint of consumer goods and the differences between linear and circular economies.
- **Take action** to find the best solutions for reducing resource consumption at global and local scales.

● We will reflect on this learner profile attribute ...

- Inquirer – we will develop our skills for inquiry and research.

◆ Assessment opportunities in this chapter:

- ◆ Criterion A: Knowing and understanding
- ◆ Criterion B: Investigating
- ◆ Criterion C: Communicating
- ◆ Criterion D: Thinking critically

■ These Approaches to Learning (ATL) skills will be useful ...

- | | |
|----------------------------|-------------------------------|
| ■ Collaboration skills | ■ Information literacy skills |
| ■ Communication skills | ■ Media literacy skills |
| ■ Creative-thinking skills | ■ Reflection skills |
| ■ Critical-thinking skills | ■ Transfer skills |

KEY WORDS

circular	resources depletion
economy	supply
flow	sustainability
linear	

SEE–THINK–WONDER

Study the photos in Figures 5.2 and 5.3.

What do you see? Make sure your observations are as accurate as possible.

Identify the similarities and differences between the photos. What are the benefits and problems of each technique?

Why might the techniques used be so different despite the fact that they are extracting the same natural resource?

What other questions could help you **explore** the topic further?



■ **Figure 5.2** Fishermen in the North Sea



■ **Figure 5.3** Fishermen in Senegal

In this chapter we will be finding out how natural resources are used and how they have contributed to the success of powerful global businesses. We will explore the role of multinationals in controlling the global flow of goods and the supply chain of **manufactured products**. We will also evaluate the social and environmental impacts of consumer behaviour and debate the effectiveness of methods used to achieve **sustainability**.

What is the world pattern of resource production and consumption?



■ **Figure 5.5** Rare Earth Elements (REEs), also called Rare Earth Metals (REMs)

renewable if the rate at which they are depleted is not above the rate at which they regenerate.

A non-renewable resource is one that is in limited supply. It is finite, meaning that it cannot renew itself at all, or only at a rate that is not compatible with our human time-frame. Earth minerals and metal ores; fossil fuels, such as petroleum, coal and natural gas; and to some extent vast underground water stores called aquifers, are all non-renewable resources. Rare Earth Elements or REEs (see Figure 5.5) are relatively abundant but not easily extractable and are finite. The mining of REEs is on the increase as they are essential components for the manufacture of clean energy motors such as wind turbines, high-performance batteries, magnetic refrigeration and fuel cells that contribute to reducing greenhouse gas **emissions** and our dependence on fossil fuel. Would a move towards a carbon-free world lead to a complete depletion of the Earth's non-renewable resources?

▼ Links to: Sciences

Where are the REMs in the periodic table? **Discuss** this with the rest of the class.

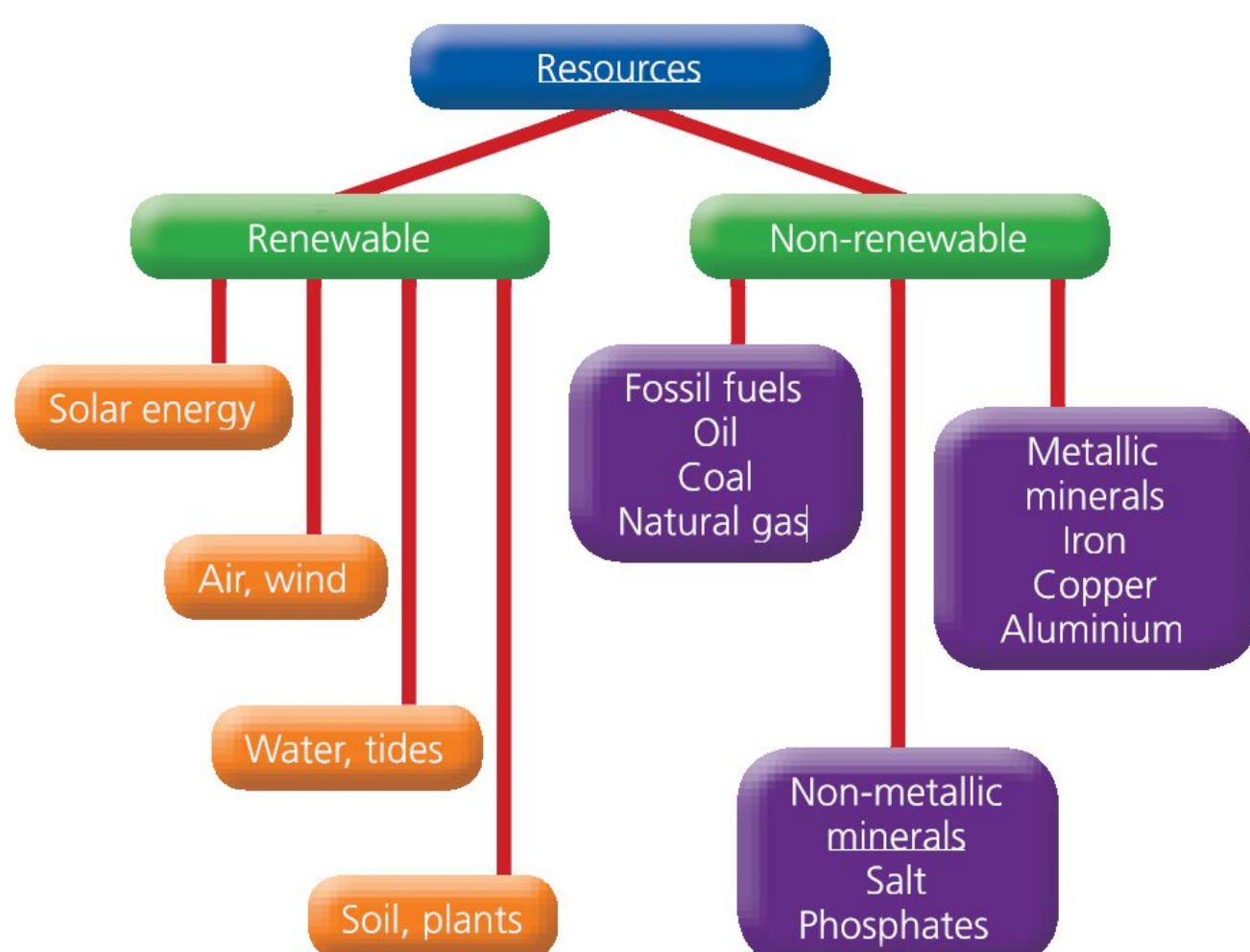
The exploitation of both renewable and non-renewable resources is an integral part of the industrial system, which is organized into extraction, production and consumption.

THINK–PAIR–SHARE

Using your prior knowledge of the Earth's natural resources, consider the following questions. Once you have got your own answers, **discuss** them with a partner. Then, share your answers with another pair.

- Which non-renewable resources are the most in demand in the world today?
- Is it possible for renewable resources to be completely depleted?
- Do you think that there should be limits on resource consumption?

Natural resources comprise all the naturally occurring material on Earth that can be used by humans for their needs. We all use natural resources such as water, air and food to fulfil our basic needs, whereas some specific resources, such as minerals, are mainly used by industries in the manufacturing process of industrial products and consumer goods. Despite the vast range, the Earth's natural resources can be put into two categories: renewable and non-renewable (see Figure 5.4).



■ **Figure 5.4** Classification of resources

A renewable resource can theoretically be used over and over again. **Biomass** components, such as soil and plants, are all replaced as part of the natural ecosystem. Nutrients are taken up by the vegetation and then returned to the soil once plants die and decompose. The soil is constantly regenerated, which allows the vegetation to grow further. The same process applies to agriculture and allows farmers to grow crops year after year. Wild animal populations, such as fish, are also a renewable resource which is replaced naturally, provided that it is not overexploited by the fishing industry, for example. Renewable resources can only remain

ACTIVITY: Extraction, production and consumption of resources

■ ATL

- Information literacy skills: Make connections between various sources of information

Individually or in pairs, you are going to **describe** different types of resource exploitation, **identify** examples of human activity involved in resource exploitation, and **classify** these activities into extraction, production and consumption.

- 1 Copy and complete Table 5.1, explaining what the three types of resource exploitation are. You may need to do some research online first.

Resource exploitation	Description
Extraction	
Production	
Consumption	

■ Table 5.1 Resource exploitation

- 2 Now identify the different types of resource exploitation you described in Table 5.1 in the photos below. Copy and complete Table 5.2, making sure that you accurately state the evidence you are referring to (see page 7 on how to describe photographs).

Photo	Resource exploitation type (extraction, production or consumption)	Photo evidence
(a)		
(b)		
(c)		
(d)		
(e)		
(f)		
(g)		
(h)		
(i)		

■ Table 5.2 Photo evidence

- 3 Discuss: Which photos were difficult to categorize into extraction, production or consumption and why?

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding.



■ Figure 5.6 Examples of resource exploitation



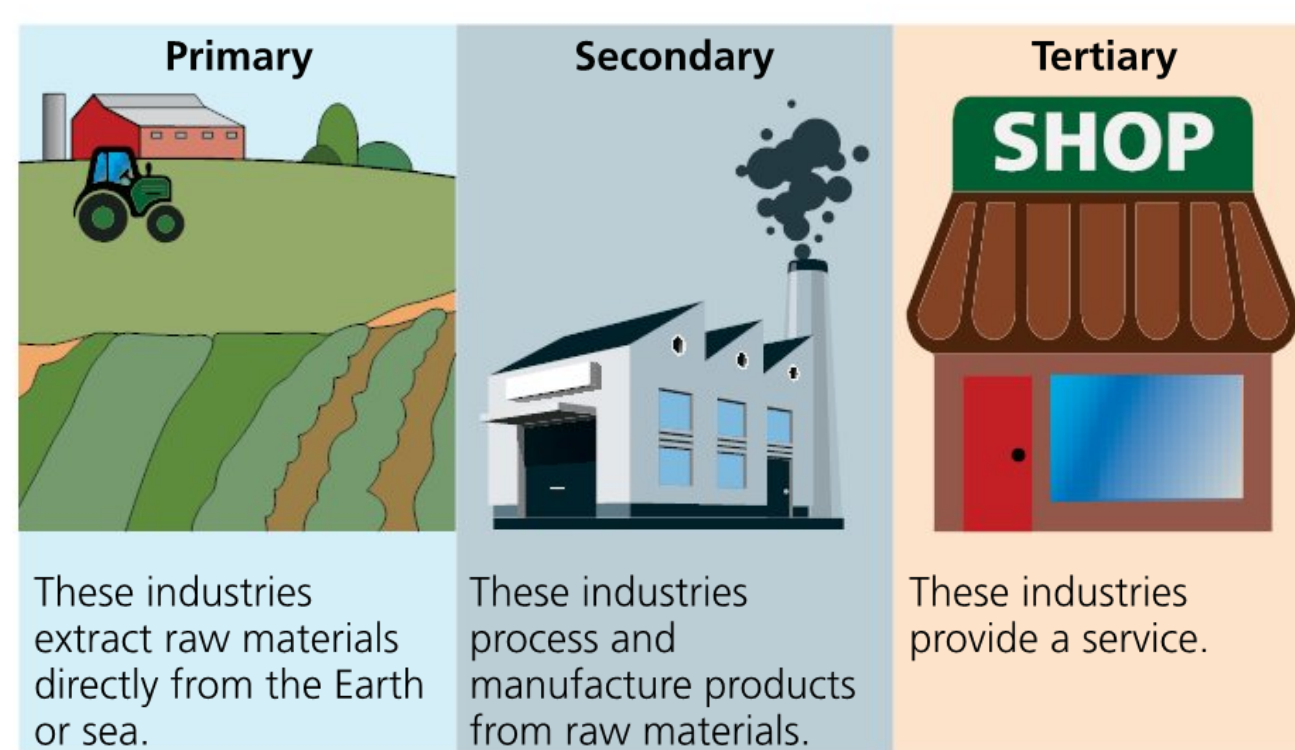
■ **Figure 5.8** Escondida open cast mine in Chile

EXPLOITATION OF NATURAL RESOURCES

The world's exploitation of natural resources is determined by a wide range of human and physical factors. Before resources can be used they have to be naturally available in quantities large enough to be exploited commercially. The production process transforms the resources into finished products in the form of goods. The objective of production is to satisfy the demand for such transformed resources. There are three different types of production (see Figure 5.7):

- Primary production is carried out by extractive industries, such as oil extraction, mining, farming, fishing and forestry.
- Secondary production is carried out by manufacturing industries. The raw material is turned into semi-finished or finished products, ready to be sold to consumers. For example, wheat can be processed into flour and then transformed into bread; iron ore can be finished into steel and then made into cars. Manufacturing industries produce cars, furniture, clothing, chemicals, etc.
- Tertiary production includes all the services that enable the finished goods to be put in the hands of consumers. They include a range of human resources which provide knowledge, financial resources and infrastructure planning and design. Examples are trade, banking, insurance, transport and communications. Governmental services such as administration, education, health and defence, are also included in the 'service industry'.

However sophisticated production systems might be, the effectiveness and competitiveness of resource exploitation



■ **Figure 5.7** Classification of production types

is still determined by the physical geography of the site in which the resource is located. To illustrate this point, we will look at mineral resources.

Mineral resources are dependent on the **geology** of places. The United Nations categorizes a mineral deposit as a reserve when it is a body of naturally occurring geologic material, from which, by concentration, enrichment or other processes, a commodity can be mined profitably, qualifying it to be categorized as reserve. Countries with high concentrations of minerals, such as metal ores, and with deposits large enough to be commercially viable, have become major producers and exporters to the rest of the world. Chile is, for example, the biggest producer of copper, with its annual production representing nearly 30 per cent of the total world production in 2017. The country has the world's biggest copper mine at Escondida in Chile's Atacama Desert (see Figure 5.8), and seven out of the top 20 largest copper mines in the world. Chile exports its copper to the European Union, China and Japan.

CONSUMPTION OF NATURAL RESOURCES

DISCUSS

Material Footprint (MF) measures the total amount of raw materials required to produce the goods used by the economy of a country.

In pairs, **describe** Figure 5.9 by **identifying** countries with the highest Material Footprint and countries with the lowest Material Footprint. How can the trend be **explained**? Why do some countries require more raw material for their economic development?

Justify your points with reference to specific countries and types of resources.

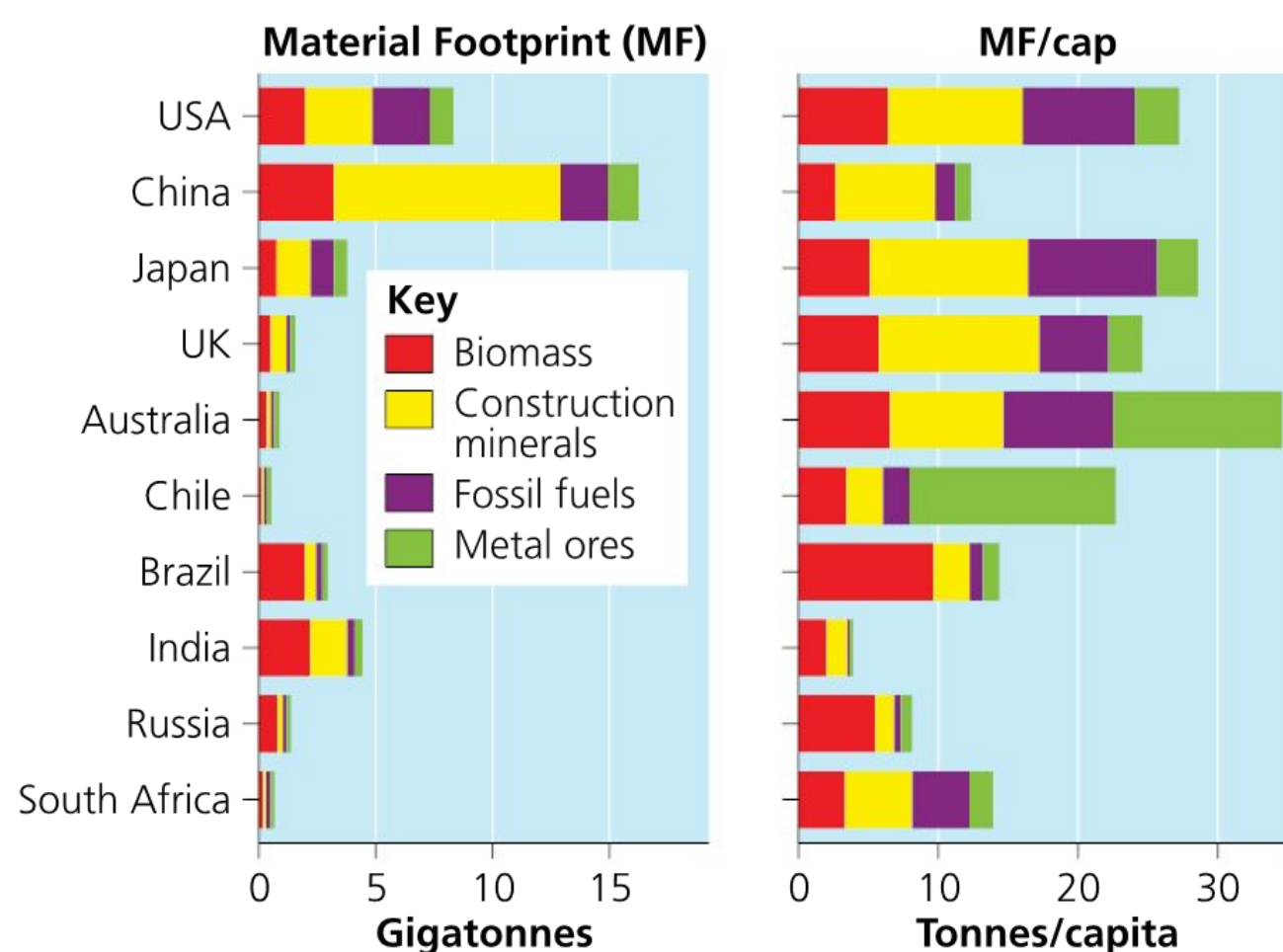


Figure 5.9 Material Footprint of raw materials required for the export of goods and services for selected countries in 2008 (totals and per capita)

The world has never been more prosperous than it is today (see Figure 5.10). Since about 1950, the global economy has grown enormously, driven by the postwar recovery of market economies such as those in the USA, Japan, Germany and the UK. Meanwhile the forces of globalization have contributed to the emergence of powerful economic giants like Brazil, Russia, India and China.

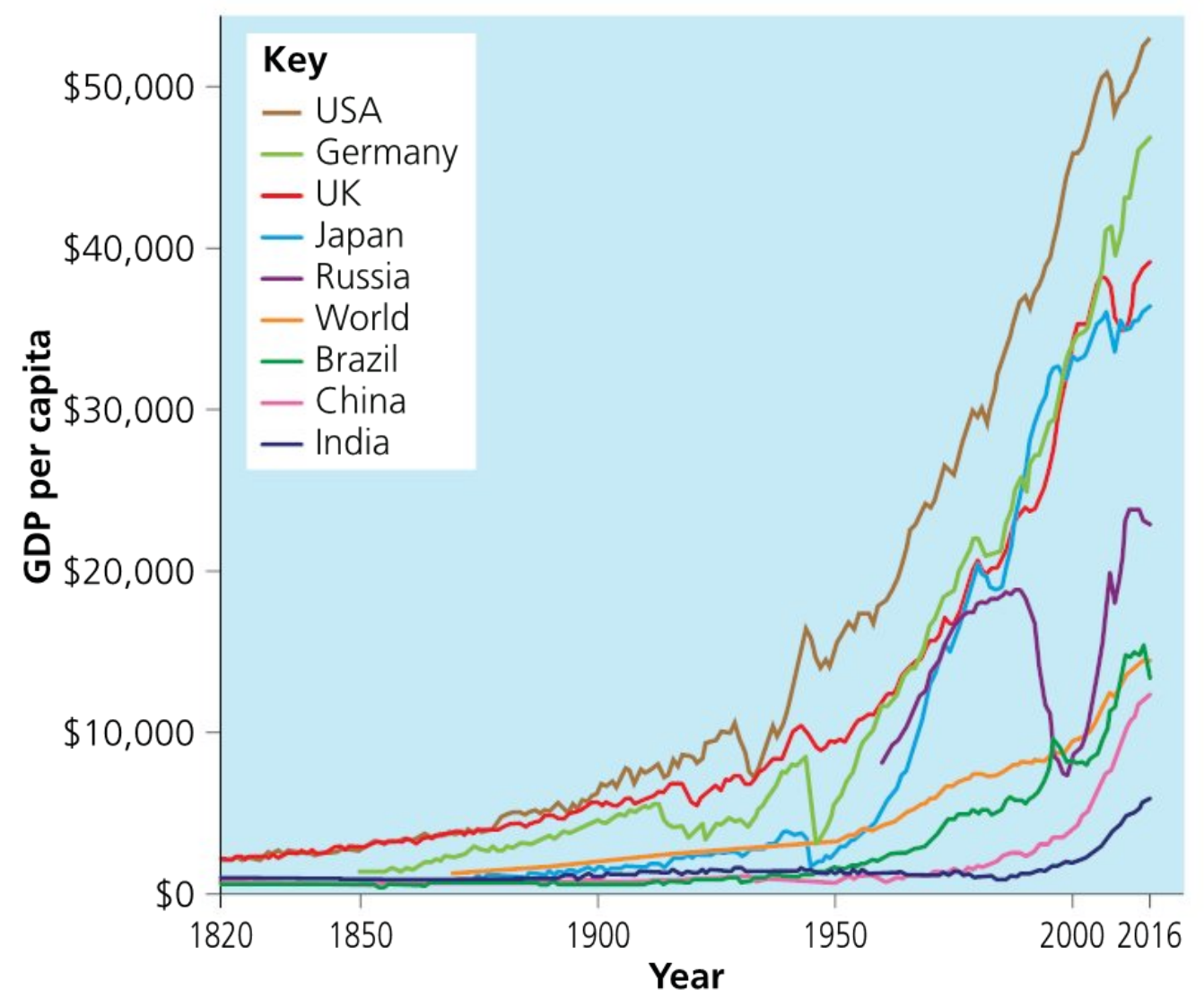


Figure 5.10 Real GDP per capita, measured using US\$, inflation adjusted at prices of 2011

Global economic growth has fuelled unprecedented rates of consumption, such as the following:

- Global meat consumption has grown. The average person consumed around 33 kg of meat in 1993 and around 43 kg in 2013.
- Global electricity consumption has nearly doubled, from 11,486 billion kilowatt hours in 1995 to 21,153 billion kilowatt hours in 2015. In 2017, China was the highest consumer of electricity in the world with the USA following close behind.
- Global car sales rose from 39.2 million cars sold in 1990 to 81.5 million cars in 2018. In some regions, such as Asia, consumption is increasing at an alarming rate. In China, the number of cars sold quadrupled in just 10 years from 6.76 million cars in 2008 to 24.72 million cars in 2018.

In the following activities we will see that the use and consumption of natural resources differ globally. The amount of resources needed and the value attached to them by different populations is also changing over time. Population growth (see Chapter 2) and increasing living standards have become the two determining factors in the global consumption of natural resources.

ACTIVITY: Global production and consumption of natural resources

■ ATL

- Critical-thinking skills: Practise observing carefully in order to recognize problems

Analyse the maps in Figures 5.11 to 5.19 on pages 97–98, which show global income and selected natural resources, and answer the questions below. You can also **explore** more maps of global resource consumption by visiting: <https://ourworldindata.org/>

- 1 For each type of resource, **compare and contrast** the **spatial distribution** of production and consumption.

Hint

Remember to use the TEA description technique to help you structure your answers (see page 12).

You could copy and complete Table 5.3 in order to help you answer this question.

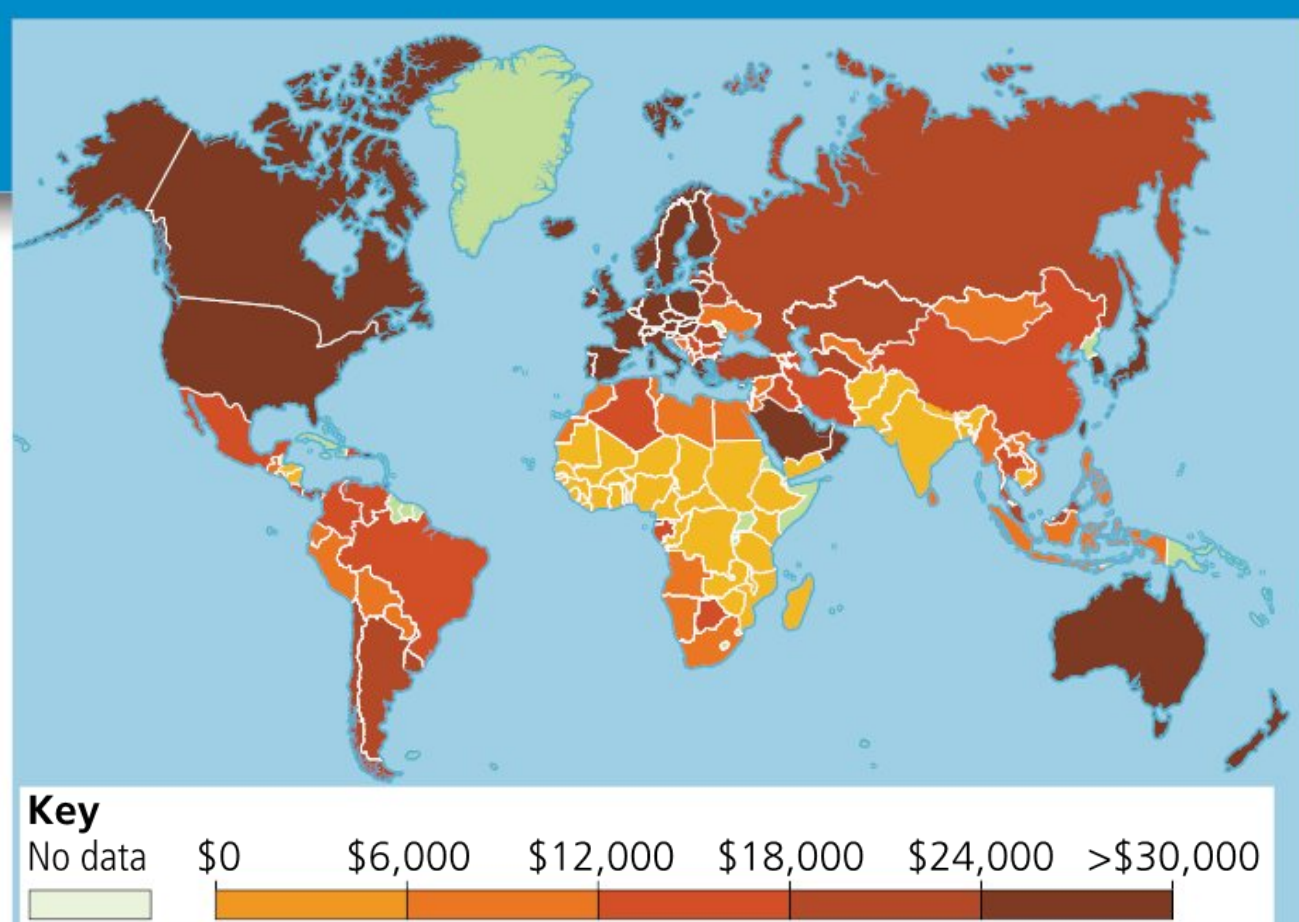
Type of resource	Production	Consumption	Similarities and/or differences
Oil	T:		
	E:	E:	
	A:	A:	
Meat	T:		
	E:	E:	
	A:	A:	
Fish	T:		
	E:	E:	
	A:	A:	
Water	T:		
	E:	E:	
	A:	A:	

■ **Table 5.3** Production and consumption of resources

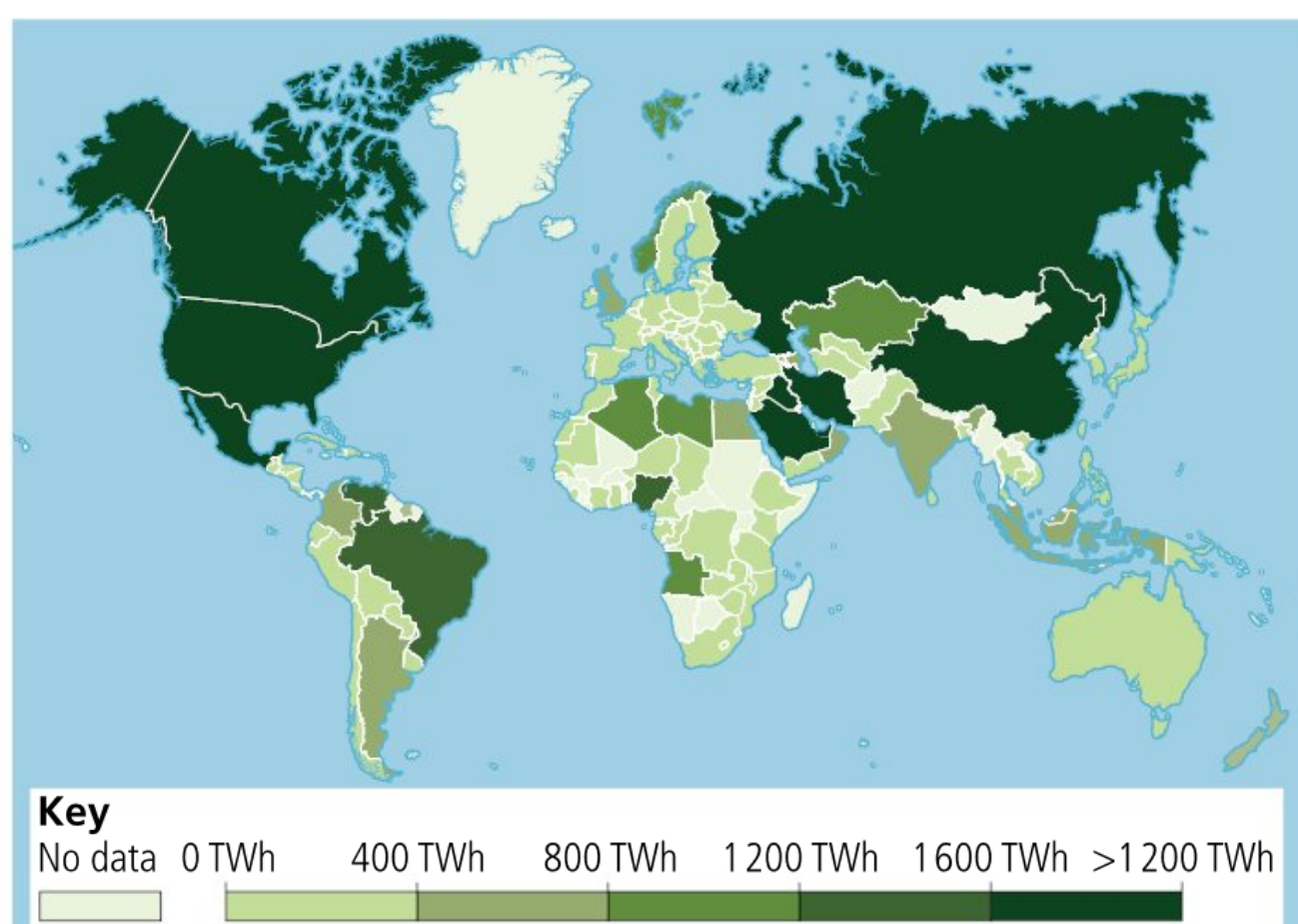
- 2 What does the spatial distribution of production and consumption tell you about the varying levels of economic development in different regions of the world?
- 3 To what extent are richer countries dependent on resource-producing countries for their economic development?

◆ Assessment opportunities

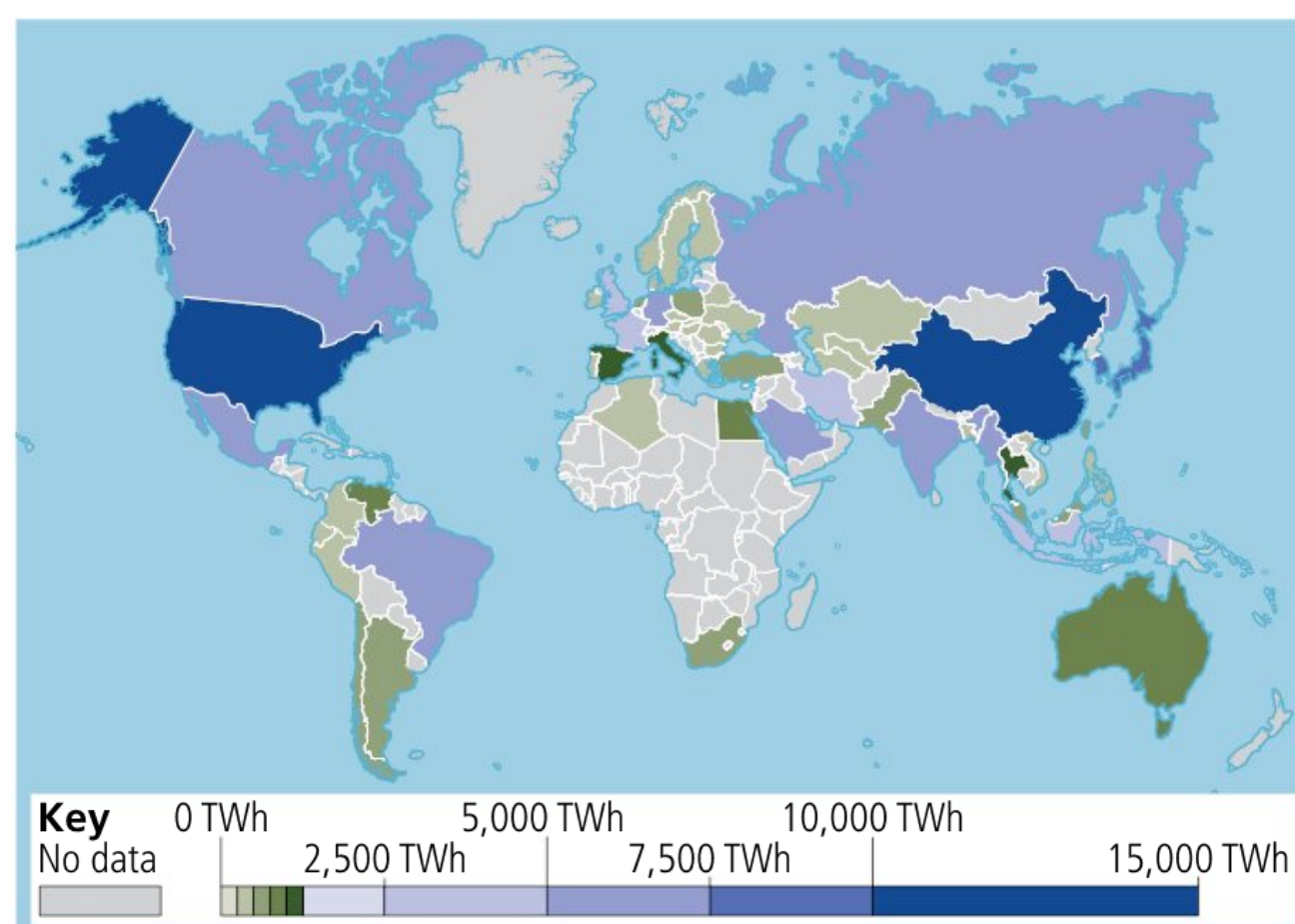
- ◆ This activity can be assessed using Criterion D: Thinking critically.



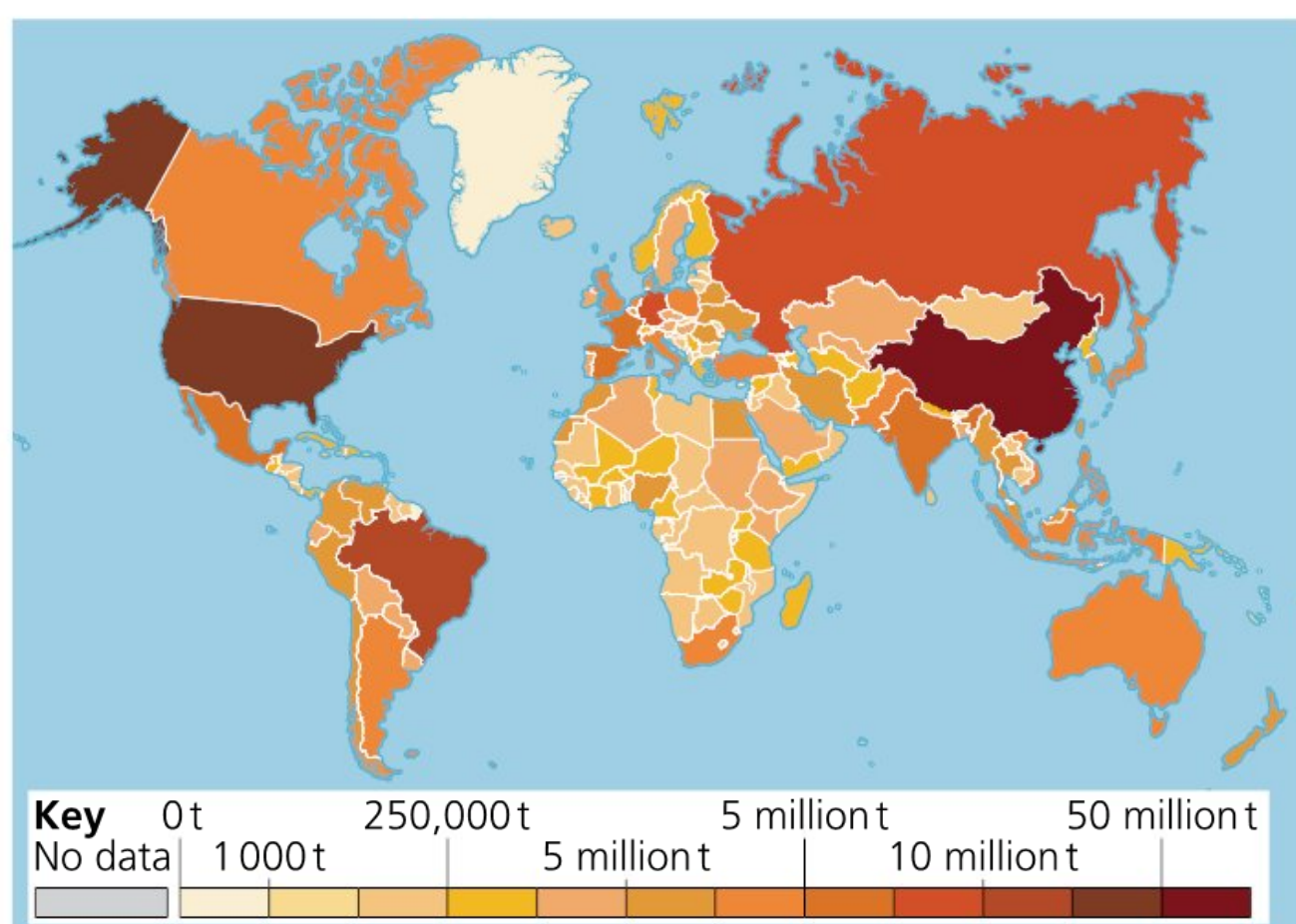
■ **Figure 5.11** Average real GDP per capita across countries and regions, 2016



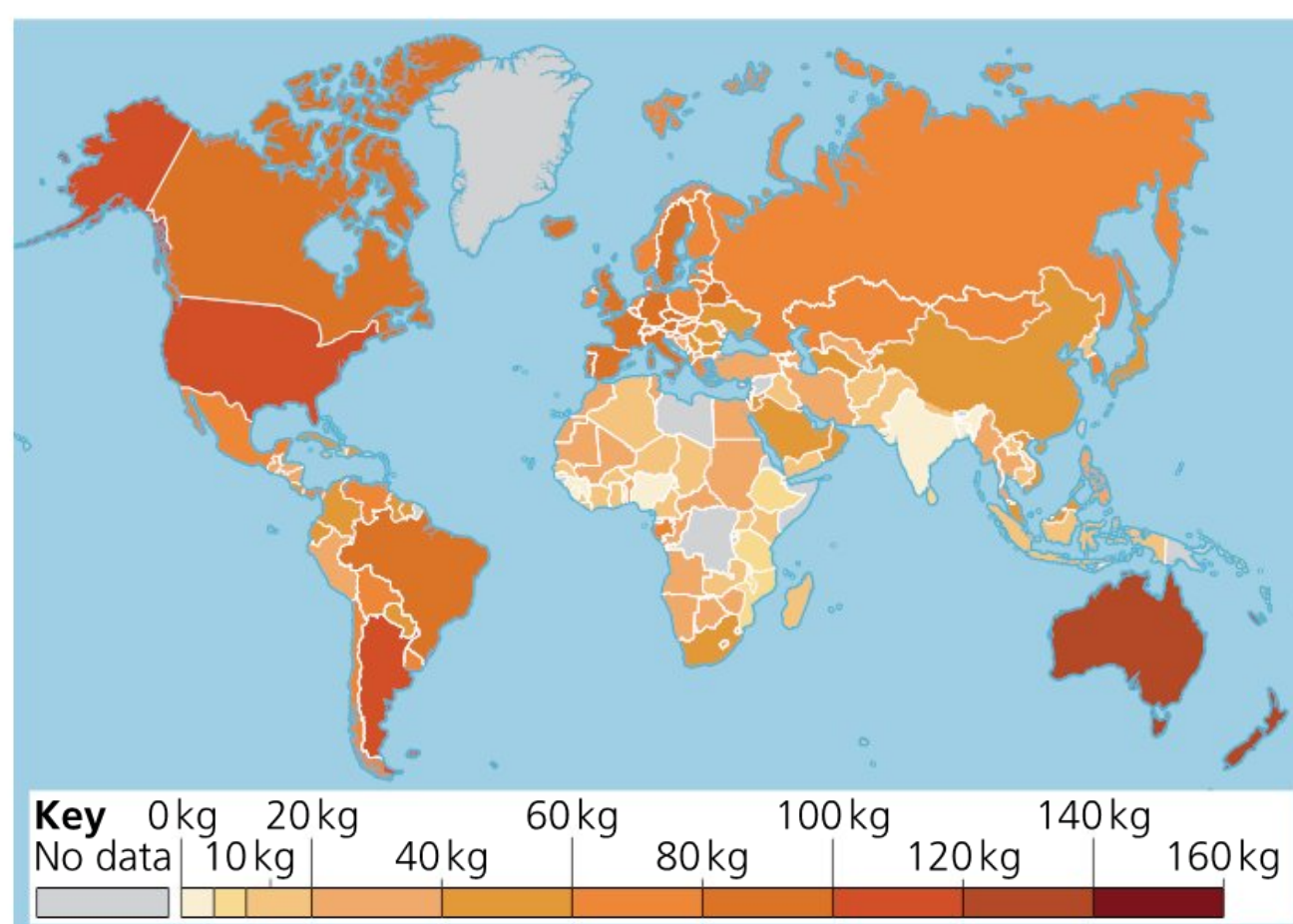
■ **Figure 5.12** Oil production by country, terawatt-hours (TWh), 2012



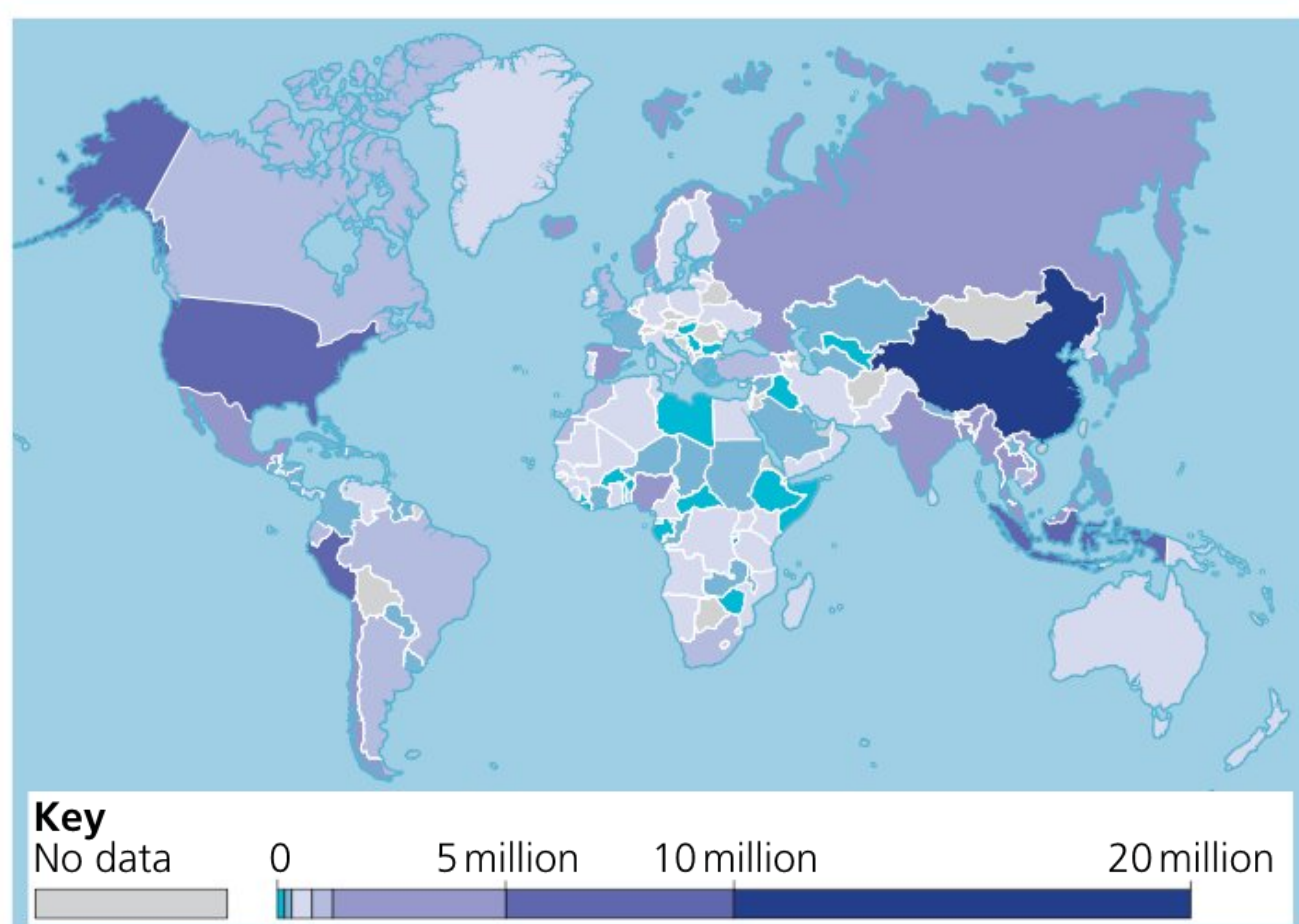
■ **Figure 5.13** Oil consumption by country, terawatt-hours (TWh), 2012



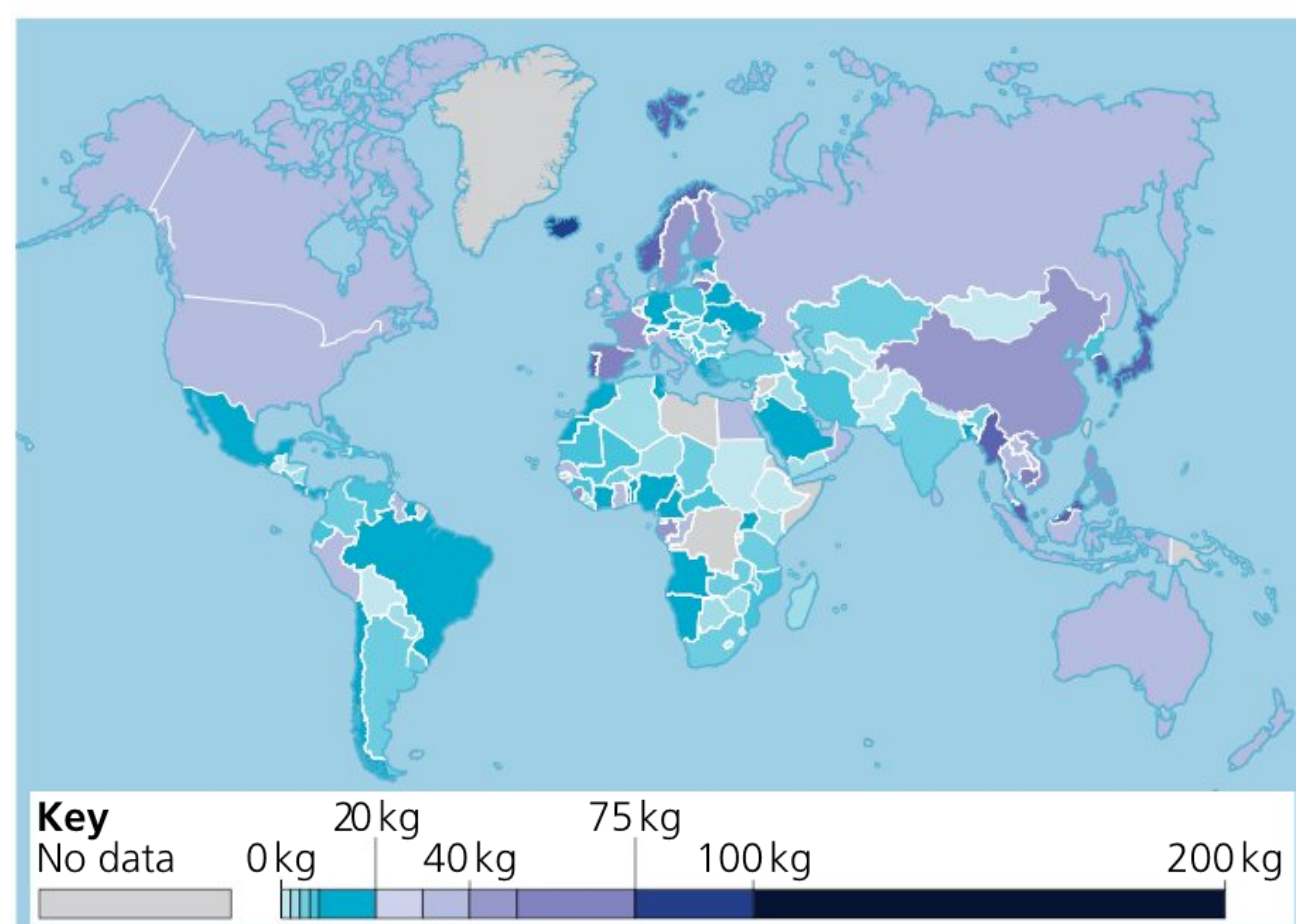
■ **Figure 5.14** Meat production by country, tonnes, 2011



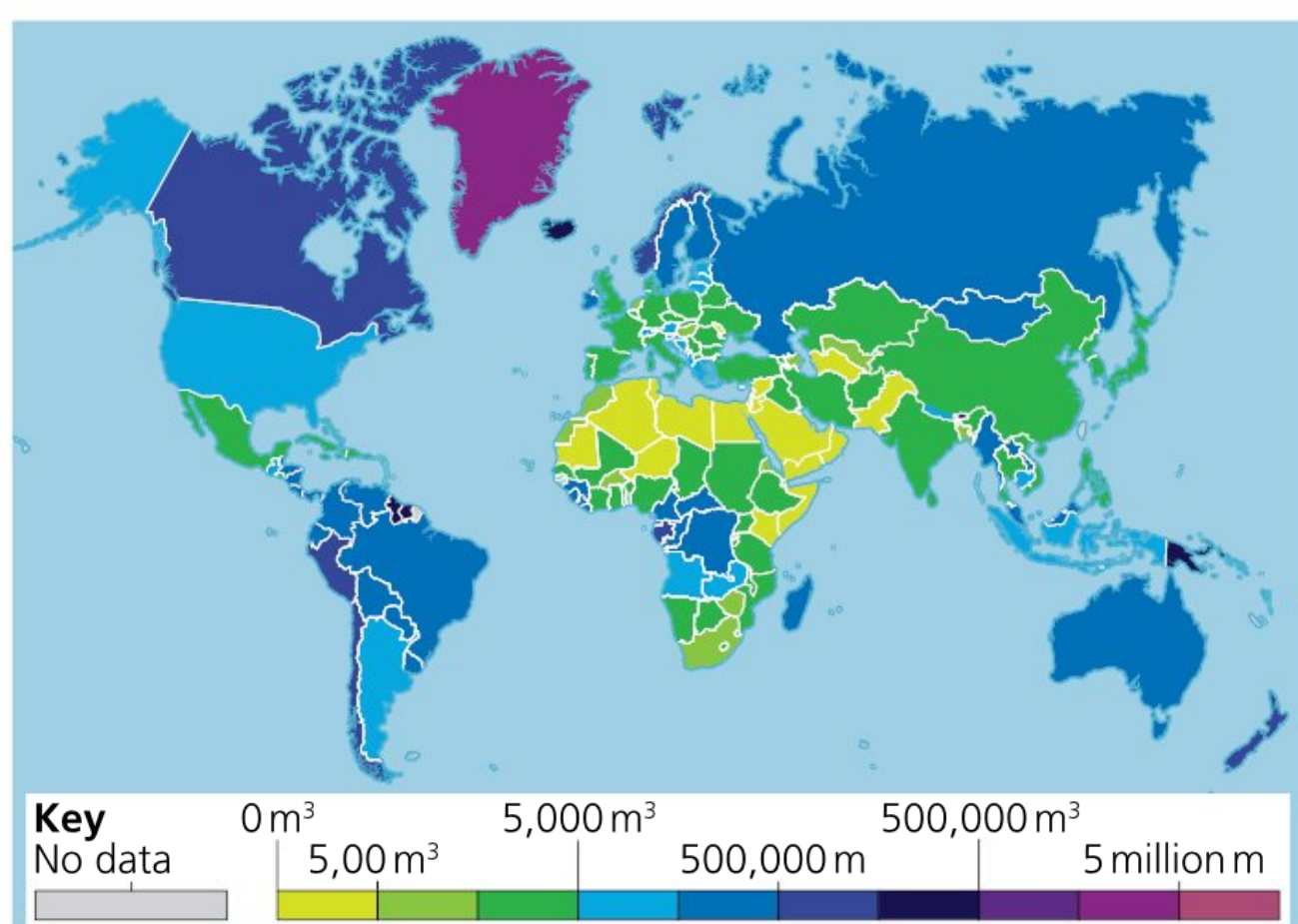
■ **Figure 5.15** Meat supply per person by country, kilograms per year, 2011



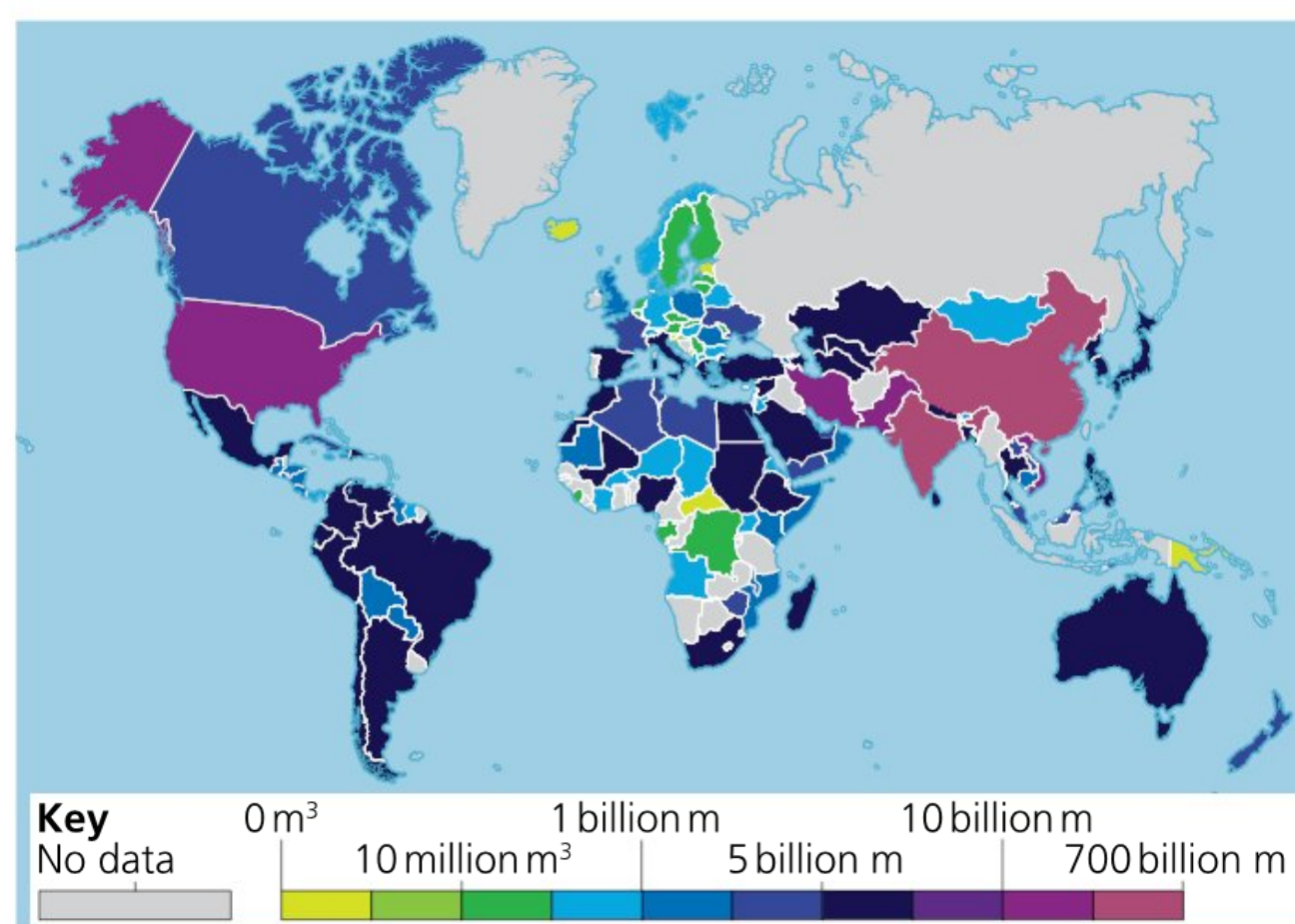
■ **Figure 5.16** Capture fisheries production by country, tonnes per year, 2011



■ **Figure 5.17** Fish and seafood consumption per capita by country, 2011



■ **Figure 5.18** Renewable internal freshwater resources per capita by country, cubic metres, 2012



■ **Figure 5.19** Agricultural water withdrawals by country, 2010

EXTENSION: GOING FURTHER ...

■ ATL

- Critical-thinking skills:
Interpret data
- Media literacy skills:
Understand the impact of media representations and modes of presentation

Visit this website:

<https://ourworldindata.org/>

Investigate **temporal** changes in global production and consumption of key resources and then **summarize** your findings in a report.

You could **investigate** data sets from the food, energy and environment subsections on the website.

You can use the generic inquiry organizer in Figure 5.20 to help you structure your report.

Your report should be between 700 and 1500 words.

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion D: Thinking critically.

- 1 • **Formulate** a clear and focused inquiry question.
 - Break down the key concepts and key ideas from the *statement of inquiry* for this chapter.
 - Brainstorm, in pairs or as a group, the meaning of each key term contained in the statement of inquiry.
 - Make your question *place* specific by using a location name, a region or a country. Stating a date or a time period will make your question even more focused.
 - Don't forget to **justify** the relevance of your research question to the statement of inquiry by explaining the links between your question and the key concepts.

- 2 • **Plan** your investigation: how will you conduct your research?
 - Research the resources you would like to investigate.
 - Make sure you use a variety of additional secondary sources such as:
 - news websites
 - Worldmapper <https://worldmapper.org/>
 - Use websites such as:
 - <https://data.worldbank.org/>
 - ArcGIS layers
 - Google Earth
 - photographs.

- 3 • **Select** the most suitable techniques to **present** and process your information:
 - maps and charts from Gapminder, World Bank Open data or Worldmapper websites or your own design
 - screenshots from Google Earth showing data layers
 - annotated photographs.
 - You could also use statistical calculations to test the relationship between development data and resource consumption and production.
 - Do not forget to **justify** your choice of presentation techniques.

- 4 • **Analyse** the impacts from resource exploitation and consumption on the planet using the SEEP structure:
 - **S:** social impacts (people and society)
 - **E:** economic (damage and rebuilding cost, impacts on a range of industries, agriculture, tourism)
 - **E:** environment (in the case of an associated environmental disaster)
 - **P:** political (national and local governments).
 - **Describe** the patterns from maps and the trends from charts using the TEA technique (see page 12) quoting specific examples and data for each country or region.
 - **Explain** the reasons for the range of impacts observed – both general trends and anomalies – and **suggest** possible reasons for them. This will need extra research!
 - Throughout your analysis, refer to your inquiry question – what evidence answers it and what evidence does not?
 - **Compare** different types of data; for example, the patterns on your maps and the trend on charts. Can you observe any correlation?
 - **Suggest** links to the key concepts of time, place and space.

- 5 • **Conclude** your investigation by writing one or two sentences that answer your inquiry question. Make sure you include your best two or three pieces of evidence to substantiate your points.
 - **Evaluate** the investigative process. In your response, you should reflect on the:
 - research question
 - research methodology used
 - outcome of your inquiry.

■ Figure 5.20 Generic inquiry organizer

ACTIVITY: Analysing the relationship between energy use and wealth

■ ATL

- Critical-thinking skills: Evaluate evidence and arguments
- Information literacy skills: Process data and report results

In this activity, you will **assess** the relationship between **Gross Domestic Product (GDP)** and energy use data and **analyse** the correlation between countries' wealth and how much energy they consume.

- 1 Study the data in each column of Table 5.4. Make sure you understand what the units represent.
- 2 Present the data by **plotting** the GDP and energy use values into a scatter graph. If you are not sure how to do this, refer to page 13.
In pairs, **discuss** what other visual presentations might be suitable to show the relationships between the two data sets.

Hint

You may wish to use a spreadsheet to produce your graph, making sure you select the scatter graph option.

- 3 Interpret your graph. Make sure you refer to the distribution of points in the graph and that you **analyse** the strength of the correlation. **Summarize** your conclusions in a paragraph. In your writing, consider the following questions:
 - What factors might cause the energy use to grow proportionally to the level of wealth?
 - What factors could **explain** anomalous results?
 Using evidence, **outline** the relative importance of physical and human factors in the relationship between wealth and energy use.
- 4 Evaluate your results and methodology.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.

Country	GDP per capita (current US\$) in 2014	Energy use (kg of oil equivalent per capita) in 2014
Algeria	5,466.40	1,321
Argentina	12,245.30	2,015
Austria	51,704.50	3,763
Bangladesh	1,084.60	222
Belgium	47,352.00	4,708
Botswana	7,493.80	1,253
Brazil	12,026.60	1,485
Bulgaria	7,853.30	2,478
Canada	50,633.20	7,876
China	7,684	2,237
Congo, Dem. Rep.	487.2	390
Costa Rica	10,631.00	1,031
Denmark	62,549.00	2,873
France	43,008.70	3,659
Germany	48,042.60	3,779
Iceland	52,855.10	17,916
India	1,576.00	637
Indonesia	3,491.60	884
Japan	38,109.40	3,471
Malaysia	11,183.70	2,968
Netherlands	52,157.40	4,326
Niger	429.8	151
Nigeria	3,221.70	763
Norway	97,199.90	5,596
Poland	14,342.40	2,473
Qatar	86,852.70	18,563
Russian Federation	14,125.90	4,943
Saudi Arabia	24,575.40	6,937
South Africa	6,433.90	2,696
South Sudan	1,309.50	61
Spain	29,623.20	2,465
Sweden	59,180.20	4,966
Switzerland	86,605.60	3,060
Turkey	12,127.50	1,578
Ukraine	3,104.70	2,334
United Arab Emirates	44,443.10	7,769
United Kingdom	46,783.50	2,777
USA	54,696.70	6,956

■ **Table 5.4** GDP per capita and energy use for selected countries, 2014, Source: The World Bank

How do global interactions influence the production and consumption of resources?

THINK–PAIR–SHARE

Remind yourself what multinational and transnational corporations are (see the information panel opposite).

Think about five examples of corporations you know, then share your examples with your neighbour and try to come up with ten different examples as a pair. Finally, share your examples with the rest of the class. What is the largest number of MNCs and TNCs the class can come up with?

THINK–PUZZLE–EXPLORE

Think: First, brainstorm what you already know about the different types of corporations and what they sell and the way they operate. Think about well-known global brands to help you.

Puzzle: Then, in pairs, brainstorm and write down a **list** of questions you would like to ask about how MNCs and TNCs run their businesses. Sort these questions into factual questions, conceptual questions and debatable questions.

Explore: In pairs, research the answers to your questions.

Share your findings with the rest of the class. Could you model how a typical MNC or TNC is organized?

The global scale of the operations of both MNCs and TNCs enables them to reduce operational costs while remaining efficient. The **economy of scale** resulting from high capital investments in large production sites or operations and the use of cheaper labour in host countries make multinationals very competitive and successful. Their global economic power is unquestionable and they are gradually outperforming the economic importance of national governments. Corporations are therefore increasingly controlling the exploitation of



A multinational corporation (MNC) is an international company that has its headquarters in one country, known as the home country, but operates in several other countries known as the host countries. An MNC has investments in several countries and adapts its products and services to each individual local market in the host countries. MNCs often trade under different names or brands in different parts of the world (see Figure 5.21).



■ **Figure 5.21** One brand, different names

International corporations also include transnational corporations (TNCs). TNCs are organized in the same way as MNCs but their headquarters are often associated with research and development (R&D) centres and their operations in host countries are much more directly controlled from the headquarters in the home country.

natural resources instead of governments, especially in primary production (see Figure 5.22). The majority of resources from agriculture are produced by commercial food businesses, also known as agribusinesses, which control all the stages in the farming process. In Costa Rica, global companies Del Monte and Dole control together 68 per cent of the country's pineapple production, allowing them to set prices and establish production systems with controversial environmental and social impacts.



■ **Figure 5.22** Who controls the food system?
Source: Oxfam

Since the development of modern transport technologies such as container ships (see Figure 5.23) and commercial jet aircraft in the early 1960s, MNCs and TNCs have been contributing to the global shipment of vast amounts of natural resources from different parts of the world to places where raw material is needed as part of industrial processes. Non-perishable foodstuffs such as maize, wheat and sugar, as well as bulky goods, such as crude oil and minerals, are transported in specialized containers or bulk carriers (see Figure 5.24). As we have seen earlier in this chapter, the consumption and exploitation of natural resources have grown exponentially since the 1960s and international corporations have contributed significantly to their extraction and production.

DISCUSS: Are multinationals really that powerful?

Study Table 5.5 and reflect on what you can learn about the global economic power of corporations.

Now consider and **discuss** these questions:

- How does the size of governments and corporations compare?
- How could the global economic power of corporations impact the rate of resource exploitation?
- In which direction do you think global power is shifting – towards governments or multinationals?



■ **Figure 5.23** A container ship at sea



■ **Figure 5.24** Containers in the port of Antwerp, Belgium

Country/Company	Total revenue, 2016, billions of US\$	Country/Company	Total revenue, 2016, billions of US\$	Country/Company	Total revenue, 2016, billions of US\$
USA	3,363	Daimler	169.5	Bank of China	113.7
China	2,300	General Motors	166.4	BNP Paribas	109
Japan	1,696	AT&T	163.8	Nissan	108.2
Germany	1,523	Denmark	156.9	Chevron	107.6
France	1,308	EXOR	154.9	Fannie Mae	107.2
United Kingdom	996.3	Ford Motor	151.8	China Mobile Communications	107.1
Italy	842.5	Saudi Arabia	149.7	JP Morgan Chase	105.5
Canada	594.7	Industrial Commercial Bank China	147.7	Legal and General Group	105.2
Wal-Mart Stores	485.9	Amerisource Bergen	146.9	Nippon Telegraph and Telephone	105.1
Spain	461.3	Turkey	146.4	China Life Insurance	104.8
Australia	420.5	China State Construction and Engineering	144.5	BMW Group	104.1
Netherlands	340.8	AXA Group	143.7	Express Scripts Holding	100.3
State Grid	329.6	Amazon	136	United Arab Emirates	98.2
Brazil	311.9	Hon Hai Precision	135.1	Trafigura Group	98.1
PetroChina	299.3	China Construction Bank	135.1	China Railway Engineering	97
South Korea	297.3	Honda Motor	129.2	Prudential	97
Sinopec	267.5	Finland	128.5	Venezuela	95.6
Sweden	248.3	Total	127.9	Assicurazioni Generali	95.2
Royal Dutch Shell	240	General Electric	126.7	China Railway Construction	94.9
Volkswagen Group	236.6	Verizon	126	Home Depot	94.6
Toyota Motor	236.6	Japan Post Holdings	123	Boeing	94.6
Belgium	232.3	Allianz	122.2	Wells Fargo	94.2
Mexico	224.3	Cardinal Health	121.5	Bank of America	93.7
Berkshire Hathaway	223.6	Costco Wholesale	118.7	Greece	93.3
Switzerland	215.9	Walgreens Boots Alliance	117.4	Gazprom	91.4
Apple	215.6	Agricultural Bank of China	117.3	Nestle	90.8
Exxon Mobil	205	Ping An Insurance	116.6	Alphabet	90.3
Norway	199.8	Argentina	115.9	Siemens	88.4
McKesson	198.5	Kroger	115.3	Portugal	87.3
Austria	187.3	India	114.8	Carrefour	87.1
BP	186.6	Indonesia	114.8	Dongfeng Motors	86.2
Russia	186.5	SAIC Motors	113.9	Microsoft	85.3
UnitedHealth Group	184.8				
CVS Caremark	177.5				
Samsung Electronics	174				
Glencore International	173.9				

■ **Table 5.5** The top 100 economic powers in 2016

ACTIVITY: How much water is needed to produce our foodstuffs?

■ ATL

■ Critical-thinking skills: Interpret data

- 1 Study Table 5.6, which shows typical values for the volume of water required to produce common foodstuffs.
- 2 Present the data using a suitable graph technique.
- 3 Interpret the data from your graph and the table. Can you identify a trend?
- 4 Suggest reasons why there is a significant range in the data.
- 5 Read this article: www.nytimes.com/2014/03/08/opinion/meat-makes-the-planet-thirsty.html
 - What does the article tell you about the impacts of the global demand for food on water resources?
 - What is the role played by food multinationals in global water consumption?

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.

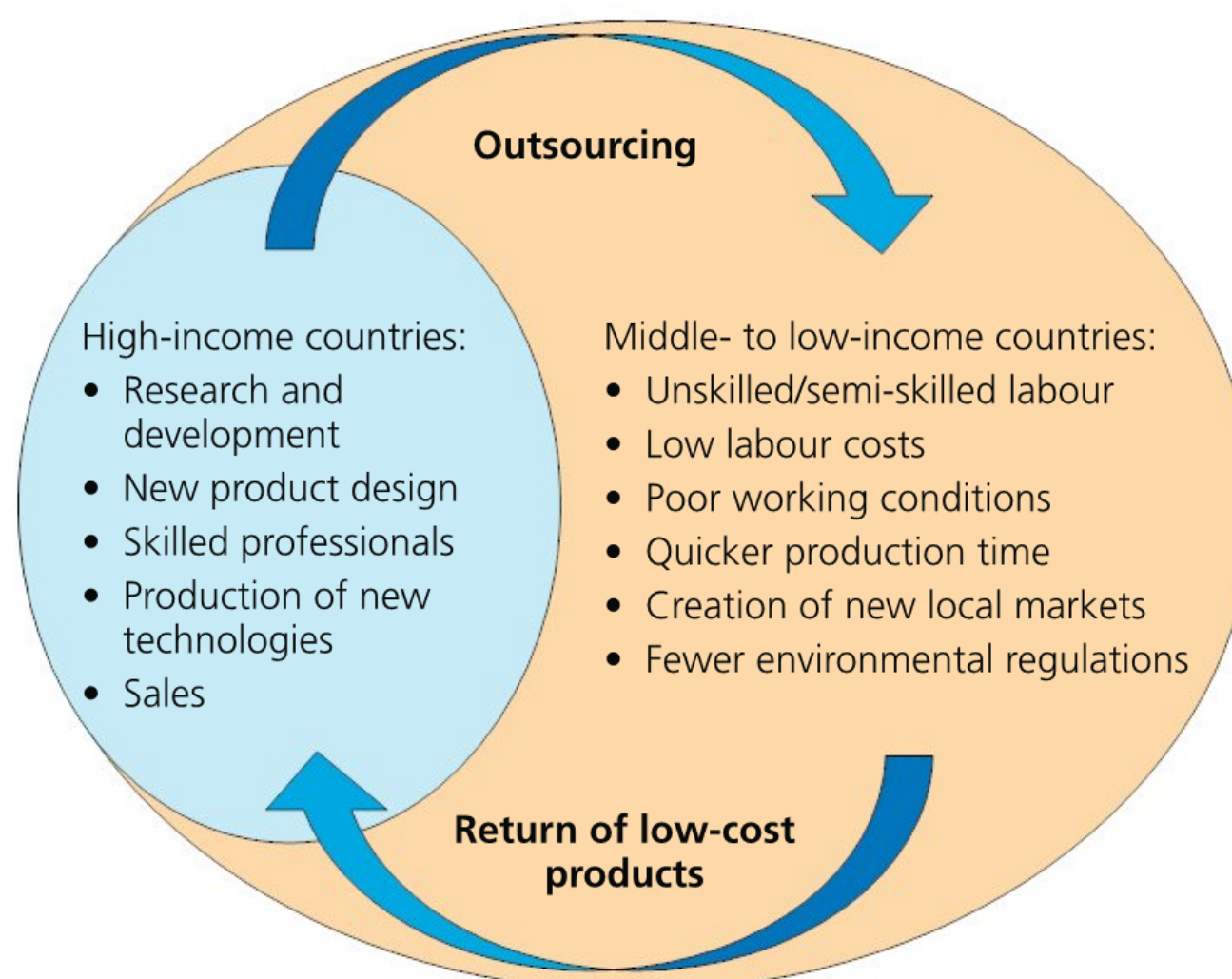
Foodstuff	Quantity	Water consumption, litres
Chocolate	1 kg	17,196
Beef	1 kg	15,415
Sheep Meat	1 kg	10,412
Pork	1 kg	5,988
Butter	1 kg	5,553
Chicken meat	1 kg	4,325
Cheese	1 kg	3,178
Olives	1 kg	3,025
Rice	1 kg	2,497
Cotton	250 g	2,495
Pasta (dry)	1 kg	1,849
Bread	1 kg	1,608
Pizza	1 unit	1,239
Apple	1 kg	822
Banana	1 kg	790
Potatoes	1 kg	287
Milk	1 x 250 ml glass	255
Cabbage	1 kg	237
Tomato	1 kg	214
Egg	1	196
Wine	1 x 250 ml glass	109
Beer	1 x 250 ml glass	74
Tea	1 x 250 ml cup	27

■ **Table 5.6** Typical values for the volume of water required to produce common foodstuffs, from the Institute of Mechanical Engineers

The global improvements in transport technologies have been followed by an improvement in information and communication technologies (ICT) over the last 30 years. Satellite systems, optical cables and mobile network developments have helped to establish a fast and efficient internet all over the globe. These technologies have become essential for the operations and industrial production systems of TNCs. As more and more countries are transitioning into internet-based economies, TNCs are able to outsource the production of goods to other countries to save time and money. Outsourcing involves businesses hiring outside companies to make components and products at a cheaper cost (see Figure 5.25).

Outsourcing plays a significant role in the supply chain of electronic goods and in particular in the production of semiconductors for computers and smartphones. This secondary industry is resource intensive and generates a number of environmental issues in terms of the

depletion of REEs and growing consumption due to rapid product obsolescence.



■ **Figure 5.25** Outsourcing by TNCs

ACTIVITY: Outsourcing

■ ATL

- Information literacy skills: Make connections between various sources of information
- Reflection skills: Consider content

Before you begin, **search** the terms in the box below to **find** definitions. Write down the definitions.

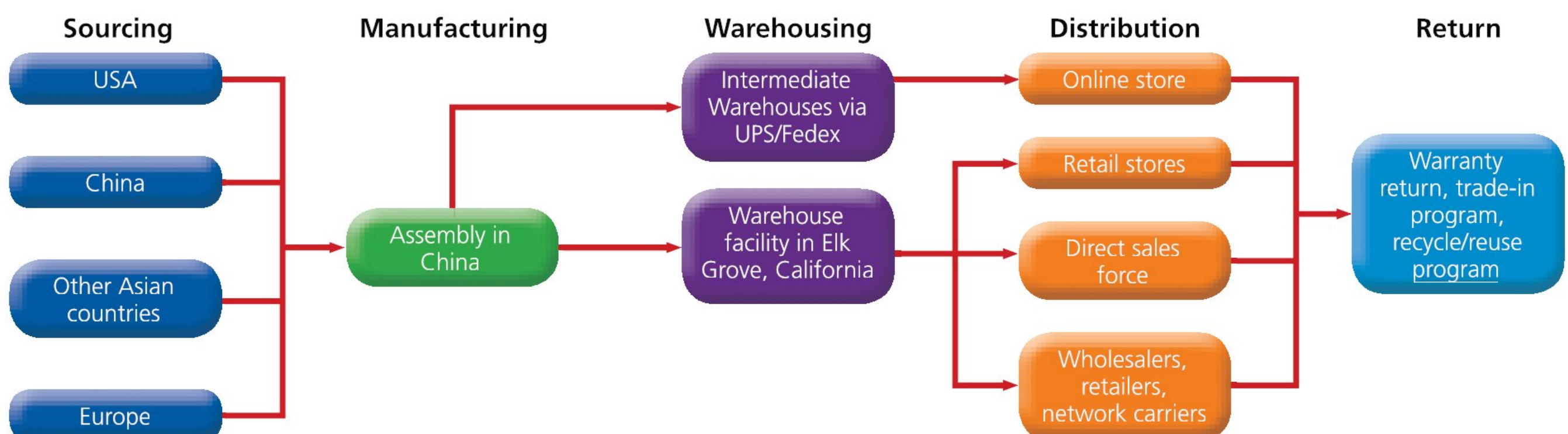
globalization, supply chain, outsourcing, offshoring, international division of labour, foreign direct investment

- 1 **Suggest** what benefits outsourcing brings to multinationals, consumers and workers. **Evaluate** the industrial process of outsourcing for national governments, workers and consumers.
- 2 Now read this article:
www.forbes.com/sites/deeppatel/2017/07/17/the-pros-and-cons-of-outsourcing-and-the-effect-on-company-culture/
 Add extra points to your answers to Question 1 based on the article.
- 3 Think back to Chapter 2. **Compare** the ways in which outsourcing is similar to labour migration. **Discuss** the costs and benefits for countries involved in this industrial process.
- 4 **Reflect** on what you have learnt about outsourcing:
 - What did I learn about today?
 - What don't I yet understand?
 - What questions do I have now?

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding.

HOW IS THE SUPPLY CHAIN OF PRODUCTS ORGANIZED?



■ **Figure 5.26** Apple's supply chain

ACTIVITY: How global are multinationals?

■ ATL

- Transfer skills: Combine knowledge, understanding and skills to create products or solutions

Individually: **research** information about the global supply chain of one significant multinational.

- 1 In a search engine, type in **global supply** followed by the name of a multinational of your choice. This is an example from the search **global supply + Boeing**: www.ghy.com/trade-compliance/new-directions-in-global-supply-chains.

Hint

For a quicker search, look at the images results first as you may find useful maps or tables showing the worldwide suppliers of your chosen multinational. You can then look at the source website for more detail.

- 2 Find out how the supply chain of products from your chosen multinational is organized across the world from ordering, making and assembling to receiving a new manufactured product.

- 3 Use ArcGIS Online to present the location of the different parts suppliers, plants, offices, research and development centres (R&D) and distribution centres with location pins or symbols. Use the arrows on *Maps notes* (from the *Add features* tool) to show how the global supply is organized between different world locations.
- 4 Use the *Change symbol* function to select the most suitable pictograms. You could also select the *Use an image* function to show a PNG, GIF, or JPEG URL-based picture of parts or products.
- 5 Compare your completed map with that of someone else in the class. In your pair, look at the similarities and differences in the way your respective multinationals are organized.
- 6 Study other maps completed in the class. Which multinationals appear to be the most global? Justify your choices.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding and criterion D: Thinking critically.

A supply chain is a network of all those involved in the production and distribution of a specific product. The supply chain represents the steps it takes to get the product or service to the customer. Many global manufacturers have had to find innovative ways to remain competitive in a global market. The revolution in information and communication technologies has enabled the development of strategic supply chain systems, which allow companies to establish successful relationships with both suppliers and customers. Global manufacturers like Apple have a well-established supply chain (see Figure 5.26).

For most transnational corporations, especially in the manufacturing industry, effective and fast supply chain systems ensure that raw materials arrive at production sites on time. Production can grind to a halt, with assembly lines stopped and the workforce unable to work, if raw materials arrive late or not properly conditioned. Any disruption in the supply chain poses the risk of companies being unable to fulfil time-sensitive orders, or being forced to obtain materials from alternative suppliers, often resulting in lower profit margins.

CASE STUDY: The supply chain of a smartphone

■ ATL

- Information literacy skills: Access information to be informed and inform others
- Collaboration skills: Help others to succeed

What is your goal?

You will **investigate** the global supply chain of a smartphone and the process this type of manufactured product goes through from its source to its end of life, and the different locations affected. You should focus on one specific brand in order to build a detailed case study.

How will you achieve this?

Work in a group of three, with each member exploring one of the following stages:

- Source
- Manufacture
- Disposal

Each member of the group should copy and complete Table 5.7, using just the column for the stage that they are exploring.

	Source	Manufacture	Disposal
Source (State your most reliable source and justify your choice with an OPVL)			
Notes (Bullet points only)			
Summary (For sharing with your group)			

■ **Table 5.7** Source, notes and summary

- 1 In row one, **state** the most reliable source you have used.
Search **smartphone raw materials** for finding out about the source stage, **Apple manufacture locations** for finding out about the manufacture stage and **smartphone e-waste** for finding out about the disposal stage.

Hint
Always remember to **evaluate** your sources. You could complete an OPVL (see page 16) on the websites used for this task.

- 2 In row two, **identify** the main features of this stage of the supply chain. Ensure you concentrate on facts, figures and located examples.
- 3 In row three, **summarize** what you consider to be the most important information in the article or website. Include one or two of the most relevant key terms, facts and examples.
- 4 Share your summaries with the rest of the group as an informal group presentation **Discuss** the extent to which multinationals contribute to the depletion of the Earth's natural resources.

◆ Assessment opportunities

◆ This activity can be assessed using Criterion A: Knowing and understanding.

Are global consumption levels sustainable?

WHAT ARE THE ENVIRONMENTAL IMPACTS OF GLOBAL RESOURCE PRODUCTION AND CONSUMPTION?

WHAT MAKES YOU SAY THAT?

What is going on in Figure 5.27 and what does it show about the effects of the global production of resources? Are the effects from this scene local, regional or global?

What makes you say that?

What effect would the area suffer from in the short term? What about in the long term?



■ **Figure 5.27** Cattle ranching on the Amazon frontier

Most industrial sectors contribute to pressures on the environment but some industrial activities have greater impacts than others. In a report to the United Nations Environment Programme, the International Panel for

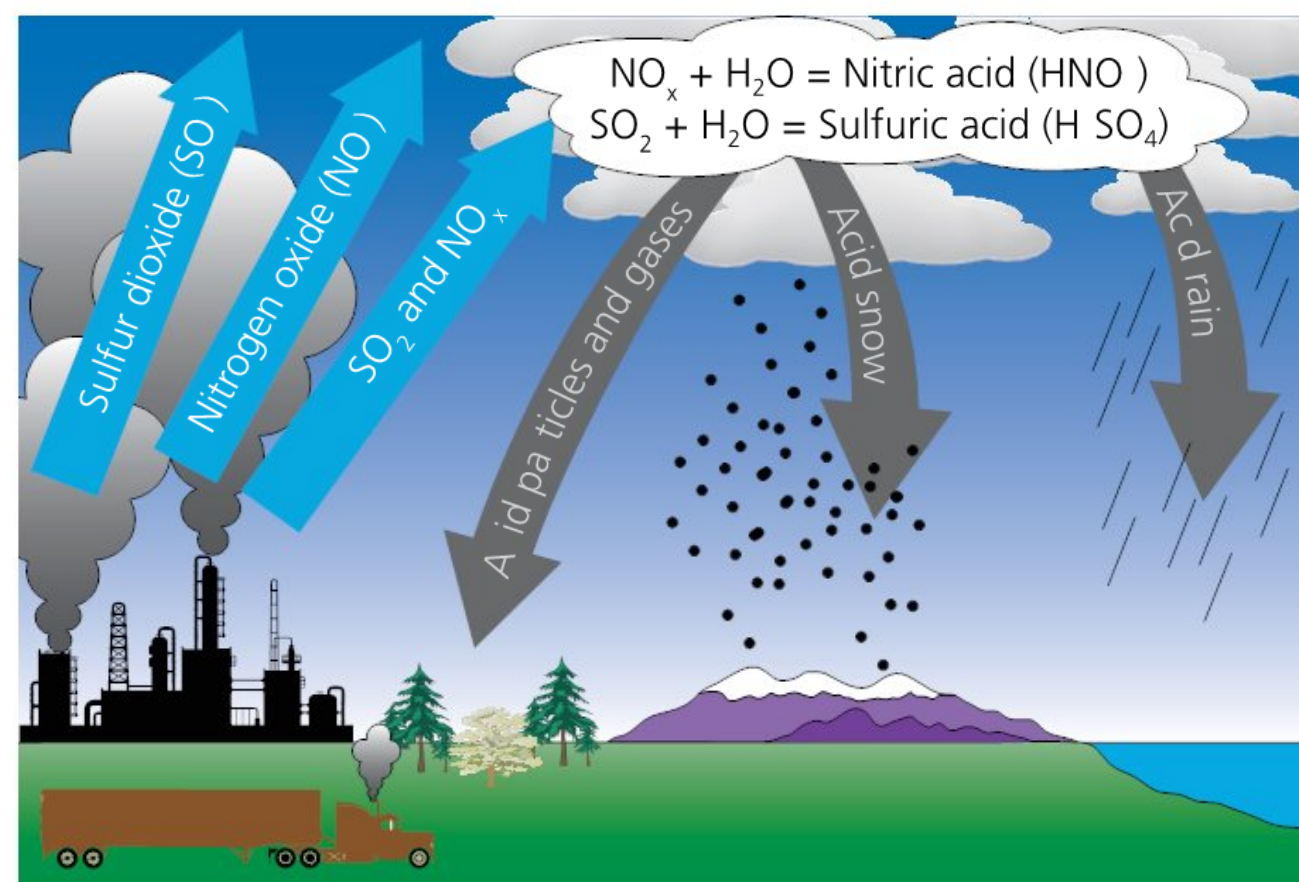
Sustainable Resource Management has identified a range of impacts from resource extraction, production and consumption.

The industries with the most harmful impacts involve fossil fuel combustion. Activities involving combustion of large quantities of fossil fuels, such as electrical utilities, residential heating, metal refining, transportation and energy intensive industries have been repeatedly identified as major contributors to environmental degradation. These activities are among the top contributors to climate change, **abiotic** resource depletion and acidification of the atmosphere and oceans (see Figure 5.28).

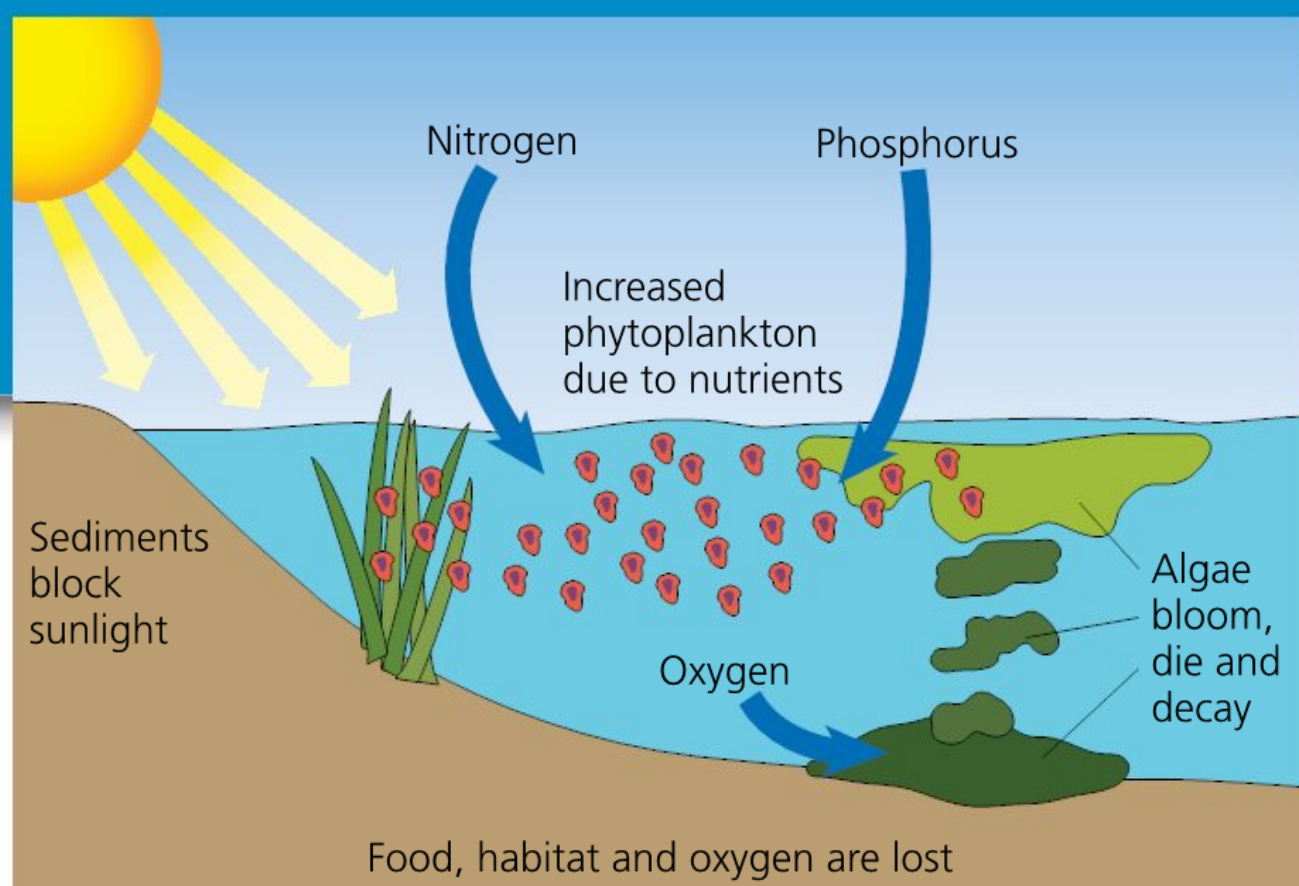
CLAIM–SUPPORT–QUESTION

Work in groups of four or five. Take turns to make a claim about the role of MNCs and TNCs in global resource extraction and consumption (an explanation or interpretation of some aspect of the topic).

Then **identify** support for your claim (ideas, concepts or evidence you know). Finally, ask a question related to your claim. (What isn't explained? What new questions does your claim raise?) Now reflect on the activity. What new thoughts do you have about the role of MNCs in global resource extraction and consumption?



■ **Figure 5.28** Atmosphere and water acidification



■ **Figure 5.29** The process of eutrophication

Agricultural activities and biomass-using activities are also significant contributors to climate change, eutrophication, ecosystem degradation and water resource depletion. The process of eutrophication (see Figure 5.29), caused by excessive use of fertilizers and chemicals in commercial farming, results in particularly acute environmental impacts on coastal margins and aquatic ecosystems, such as coastal dead zones (see Figure 5.30).

A variety of different industries use chemical products. Construction, car manufacturing and other industrial manufacturing operations require the use of chemicals. Chemical companies process raw materials, such as crude oil, into more refined products that are used throughout the manufacturing processes. Approximately 80 per cent of the chemical industry is involved in plastic production,



■ **Figure 5.30** A coastal dead zone

CASE STUDY: The impacts of global food production on tropical rainforest biomes

■ ATL

- Critical-thinking skills: Gather and organize relevant information to formulate an argument
- Media literacy skills: Locate, organize, analyse, evaluate, synthesize and ethically use information from a variety of sources and media

Visit this website: <http://arcg.is/19LSX0>

Work in three groups, each **investigating** the environmental impacts of food production in one of three major rainforest **biomes** in: Brazil, the Democratic Republic of Congo (DRC) and Indonesia.

Within each group, individuals should carry out research on **agribusiness**, **palm oil** and **shifting cultivation** for their allocated country/rainforest biome.

As a group, collate the research from each person into one short report (maximum 800 words) entitled: The impacts of global food production on tropical rainforests: Brazil/DRC/Indonesia.

Each group then reads the reports of the other groups and **summarizes** the main points.

As a class, **compare and contrast** the rates, causes and impacts of deforestation on the three rainforest biomes **investigated**. **Discuss** the extent to which you agree that global food production is affecting rainforest biomes in the same way.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion C: Communicating and D: Thinking critically.

which eventually results in worldwide pollution of the seas and oceans from plastic by-products and waste. The petrochemical industry is largely to blame for the pollution of the marine ecosystems but some less obvious sectors are also responsible. Besides the issue of fish overexploitation by the fishing industry, commercial aquaculture uses chemicals in the treatment of sea-lice infestations which are lethal to shrimp and lobsters. Lobsters exposed to high concentrations of chemicals have decreased reproductive success compared to unaffected lobsters.

ACTIVITY: Using GIS to explore the impacts of global food production on aquatic biomes

■ ATL

- Information literacy skills: Understand and use technology systems
- Critical-thinking skills: Use models and simulations to explore complex systems and issues

Work individually or in pairs.

- 1 Look at Figure 5.30. Search online for the **processes responsible for ocean dead zones**.
- 2 Read this quote from Lucia von Reusner, campaign director of the campaign group Mighty Earth (www.mightyearth.org):
'These dead zones will continue to expand unless the major meat companies that dominate our global agricultural system start cleaning up their supply chains to keep pollution out of our waters.'
- 3 Use ArcGIS Online to help you investigate the global distribution of ocean dead zones and their potential pollution sources.
Open a new ArcGIS Online map and search five map layers using the following terms: *Esri hydro reference overlay*, *Seafloor dissolved oxygen*, *GLDAS runoff dev*, *Mean annual sea surface chlorophyll-a concentration 2009-2013 (2015)* and *World land cover ESA 2010*. Once these are added to your ArcGIS Online map, your map content should look like Figure 5.31.

Refer back to pages 18–19 if you need to learn how to add layers on ArcGIS Online.



■ **Figure 5.31** Map content showing the five layers

- 4 Use the five layers and simple GIS tools to help you **identify**:
 - The most polluting types of land use. Excess fertilizer use is not only an issue with farmland but also in urban areas with gardens, parks and leisure complexes.
 - The areas with the highest rates of surface runoff. Runoff can be part of natural river systems but also a result of the development of urban areas, with some major rivers draining large urban areas.
 - The areas with the highest concentrations of chlorophyll and the lowest concentration of dissolved oxygen.
- 5 **Predict** where oceanic dead zones are most likely to be located. **Justify** your decision with reference to evidence from your ArcGIS Online map.
- 6 Working in groups, **evaluate** the statement from Lucia von Reusner. **To what extent** does your group agree with her? Use map evidence taken from your ArcGIS Online map layers (see box below) and other sources to support your judgement.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.

How to use evidence from maps

Map evidence can include the following:

- Naming a location using the printed place names on the map.
- Providing coordinates either as longitude and latitude in degrees or grid reference coordinates. On a printed paper map, the coordinates are found at the end of the lines forming the map grid system. On a digital map, use the *Find coordinates* tool from the software or application.
- **Identifying** specific features on or near a location. For this, you need to look at the map symbols and then refer to the key provided with the map to understand their meaning. This can help you **describe** the **land use** of the location you are studying.
- **Interpreting** the relief of the land. For this you will need to study the contour lines or spot heights on the map. Check the key to make sure you know the distance between each contour line. If you need more help on how to use a map, refer back to the How valuable are maps? activity on page 8.





How to use transparency and measure tools in GIS

Use the *Transparency and measure* tool on ArcGIS Online in order to help you **predict** the potential location of ocean dead zones.

- With the *Details* pane visible, click the button, *Show contents of map*. Turn on (select with a tick) the *Seafloor dissolved oxygen* layer and the *Chlorophyll-a concentration* layer. Make sure all the other layers are turned off (deselected).
- Click the three dots on the right-hand side of the *Seafloor dissolved oxygen* layer, and select *Transparency*.
- Modify the layer transparency to see the *Chlorophyll-a concentration* layer below the top layer. Slide the transparency layer from left to right several times to help you **identify** areas of high chlorophyll-a concentration and low seafloor dissolved oxygen levels. This should help to locate dead zones.
- Click the button *Measure*.
- Click the button *Distance*. Set the unit of measurement.
- On the map, click once to start the measurement at one end of an identified coastal dead zone, click again to change direction, and double-click to stop measuring at the end of your identified dead zone. Note down the distance measured. You could also use the *Measure an area* option to measure the areas affected by dead zones.

Hint

Position the area of interest on the map so that it is not obscured by the *Measure* window.

THINK–PAIR–SHARE

How would you **define** the concept of an ecological footprint? Think about the definition on your own and then share your thoughts with a partner.

Use the Oxford online dictionary to **explore** the meanings of ecological footprint:

<https://en.oxforddictionaries.com/>

In a recent study, Norwegian researchers estimated that 60–80 per cent of our impact on the planet is the result of household consumption. In poorer countries, energy consumption and access to basic food are the main causes of greenhouse gas emissions and pollution (see Figure 5.32). In richer countries, housing, mobility, processed food and manufactured products (see Figure 5.33) make up nearly three-quarters of the household consumption. The richer a country is, the more its population consumes, and the greater the impact on the planet from each inhabitant. Industrialized economies have some of the biggest **ecological footprints** in the world (see Figure 5.34). Food is of particular importance here. Rich countries eat more meat, dairy produce and processed food, all of which have a significant impact on the planet's natural resources.



■ **Figure 5.32** A woman cooking on an open fire, Jaisalmer, India



■ **Figure 5.33** Home appliance shopping in Japan

DISCUSS

Calculate your own ecological footprint by visiting this website: www.footprintcalculator.org/

Discuss with a partner the results of your own ecological footprint calculation:

- **Summarize the outcome of your consumption categories.**
- **Compare and contrast your highest consumption categories with a partner. How can you explain the differences or similarities? What consumption behaviour would you have to change in order to reduce your own footprint?**



Ecological footprint per capita of country's population

● >6.7 ● 5.1–6.7 ● 3.4–5.1 ● 1.7–3.4 ● <1.7

■ **Figure 5.34** Global ecological footprint per capita

The role of imports and exports is essential in shaping the way we consume today. Developing countries, particularly in Asia, have become the 'workshop of the world' and export huge quantities of products to developed countries. As a consequence, this leads to a transfer of the environmental impacts of consumption to countries where production takes place. For most rich countries, the carbon footprint of imports is significantly larger than the carbon footprint of exports, and conversely, the carbon footprint of exports of developing countries tends to be higher than that of their imports.

DISCUSS

Watch this video on the Story of Stuff:

<https://youtu.be/9GorqroigqM>

Why is the extraction–production–consumption–disposal model described as the source of most environmental and social issues the world is facing today?

Earlier in this chapter, we identified that income level is a determining factor in the environmental impacts of consumption. Some consumption types put more pressure on the environment than others. Transport and manufactured goods tend to be more impactful than food production. An increase in wealth therefore leads to an increase in environmental pressure and in many emerging economies, such as China, the proportion of the wealthier population is rising. How can global production and consumption be managed more sustainably with the growing pressure from population growth?

ACTIVITY: Environmental impacts of global consumption of resources

■ ATL

- Information literacy skills: Make connections between various sources of information
- Critical-thinking skills: Analyse complex concepts and projects into their constituent parts and synthesize them to create new understanding

- 1 In groups, inquire into one environmental impact resulting from the global increase in resource consumption. Relevant impacts could include: climate change, plastic pollution, e-waste, food waste, oil spills.
- 2 Explore the following:
 - a Scale of the impact (local, national or global) and location(s) affected.
 - b Causes. You could use diagrams showing a sequence to explain the processes involved (see Figure 1.17 on page 17 for how to sequence explanations).
 - c Environmental impacts. Categorize them into impacts on the natural environment and on people.
- 3 Feed back to the class in a five-minute presentation. As each group provides feedback, plot the location(s) affected on a blank paper world map or a web-based map from ArcGIS Online or Google maps.
- 4 In your groups, discuss the following:
 - With the world population expected to reach 11 billion by 2100, examine the likelihood that the environmental impacts of global resource consumption will become worse. Refer back to Chapter 2 for information on population.
 - Explore how multinationals might be encouraged to produce consumer goods that may have more positive impacts on the natural environment and people.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion B: Investigating and Criterion D: Thinking critically.

ACTIVITY: The socio-economic impacts of resource extraction, production and consumption

■ ATL

■ Critical-thinking skills: Evaluate evidence and arguments; Gather and organize relevant information to formulate an argument

The 1990s saw debates among academics, decision-makers and non-governmental organizations regarding the benefits and problems for countries with an abundance of natural resources.

More recently, new research has shifted the debate towards the idea that: 'For developing nations, an abundance of natural resources is a blessing more than a curse.'

You can read through an example research paper here: http://hdr.undp.org/sites/default/files/hdrp_2010_04.pdf

To what extent do you agree with this view? Write an essay, with reference to the work completed so far and your own knowledge, **discussing** the extent to which you agree with this view. You have one hour to complete this task.

Use a copy of the essay organizer (Table 5.8) to help you plan your answer. Once you have completed your plan, briefly **discuss** its content with a partner to assess how well you have addressed the essay question. Improve your essay plan based on the feedback received. You should do this for no more than 20 minutes. You then have 40 minutes to write your essay.

◆ Assessment opportunities

◆ In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding, Criterion C: Communicating and Criterion D: Thinking critically.

Essay plan structure	Draft plan
Introduction <ul style="list-style-type: none">• Definitions of key terms and concepts• Which scales (global, regional, national, local) are you going to address?• Case study and examples used• Direction of essay, line of discussion	Notes
Positive arguments (agree) <p>Point: keep it descriptive.</p> <p>Evidence: from case studies, use diagrams, compare and contrast figures/data/facts between several case studies.</p> <p>Explanation: make connections between different elements of the chapter, key concepts and most significant factors.</p> <p>Link: reuse the wording from the question and state how well your point(s) support the question statement.</p>	P: E: L: P: E: E: Repeat the PEEL structure for as many points as are needed to prove the argument.
Negative arguments (disagree) <p>Point: keep it descriptive.</p> <p>Evidence: from case studies, use diagrams, compare and contrast figures/data/facts between several case studies.</p> <p>Explanation: make connections between different elements of the chapter, key concepts and most significant factors.</p> <p>Link: reuse the wording from the question and state how well your point(s) support the question statement.</p>	P: E: E: P: E: E: L: Repeat the PEEL structure for as many points as are needed to prove the argument.
Conclusion <ul style="list-style-type: none">• Make an overall judgement or various conclusion points based on synthesis of all the arguments above (positive and negative).• Summarize your best <i>three</i> or <i>four</i> key pieces of evidence in support of your judgement.• Suggest an alternative or personal opinion.	Notes

■ Table 5.8 Essay organizer

How can sustainable levels of resource extraction, production and consumption be achieved?

CONSERVATION STRATEGIES

THE ODD ONE OUT

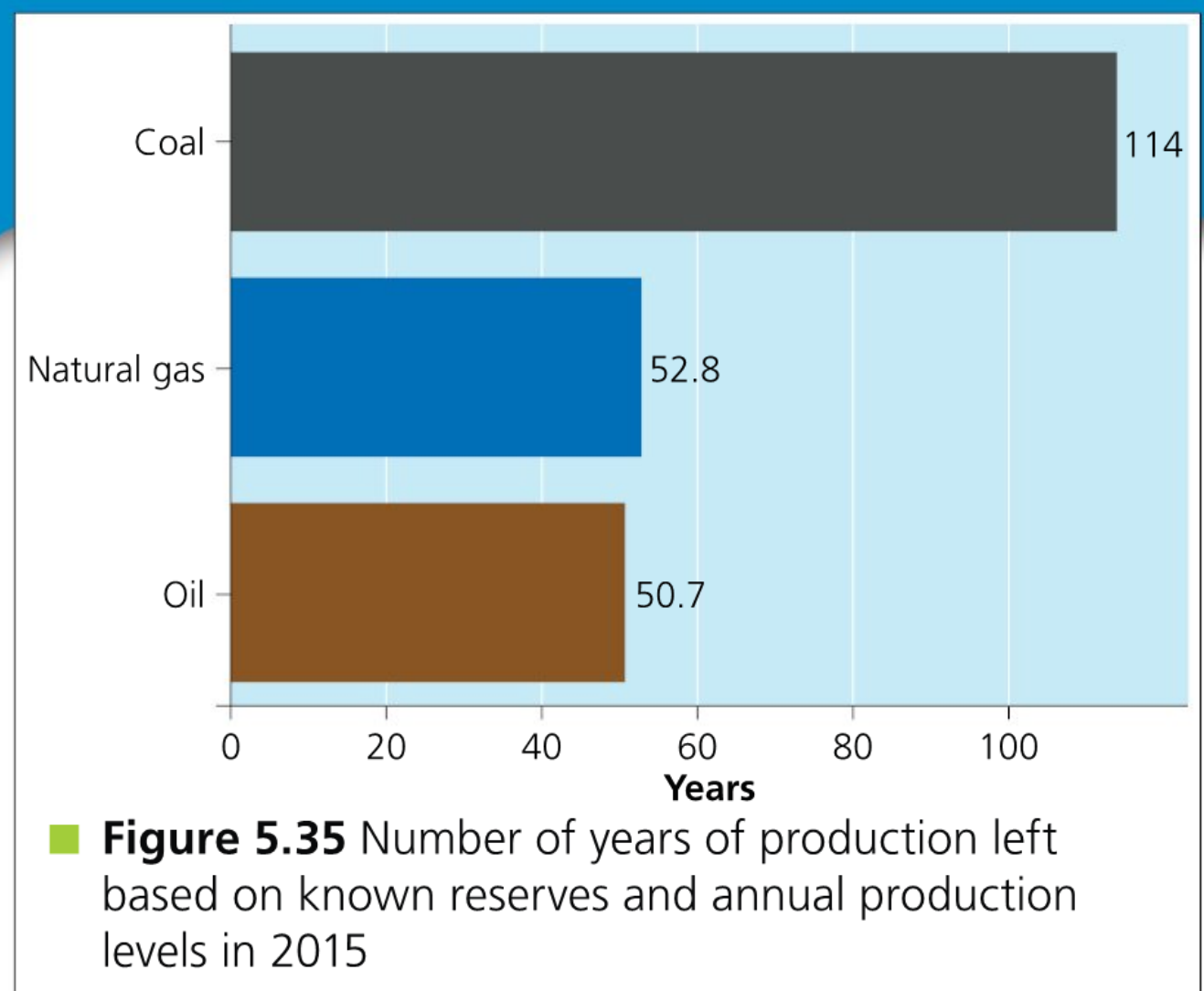
Working with a partner, study the sets of words in Table 5.9 below. In your pair, decide which word from each set is the odd one out. Be prepared to **justify** your choice with the rest of the class.

Sets	Words
A	Recycling – Reusing – Incinerating
B	Reduce – Ration – Limit
C	Consumption – Extraction – Exploitation
D	Conservation – Preservation – Protection
E	Renewable – Non-renewable – Finite

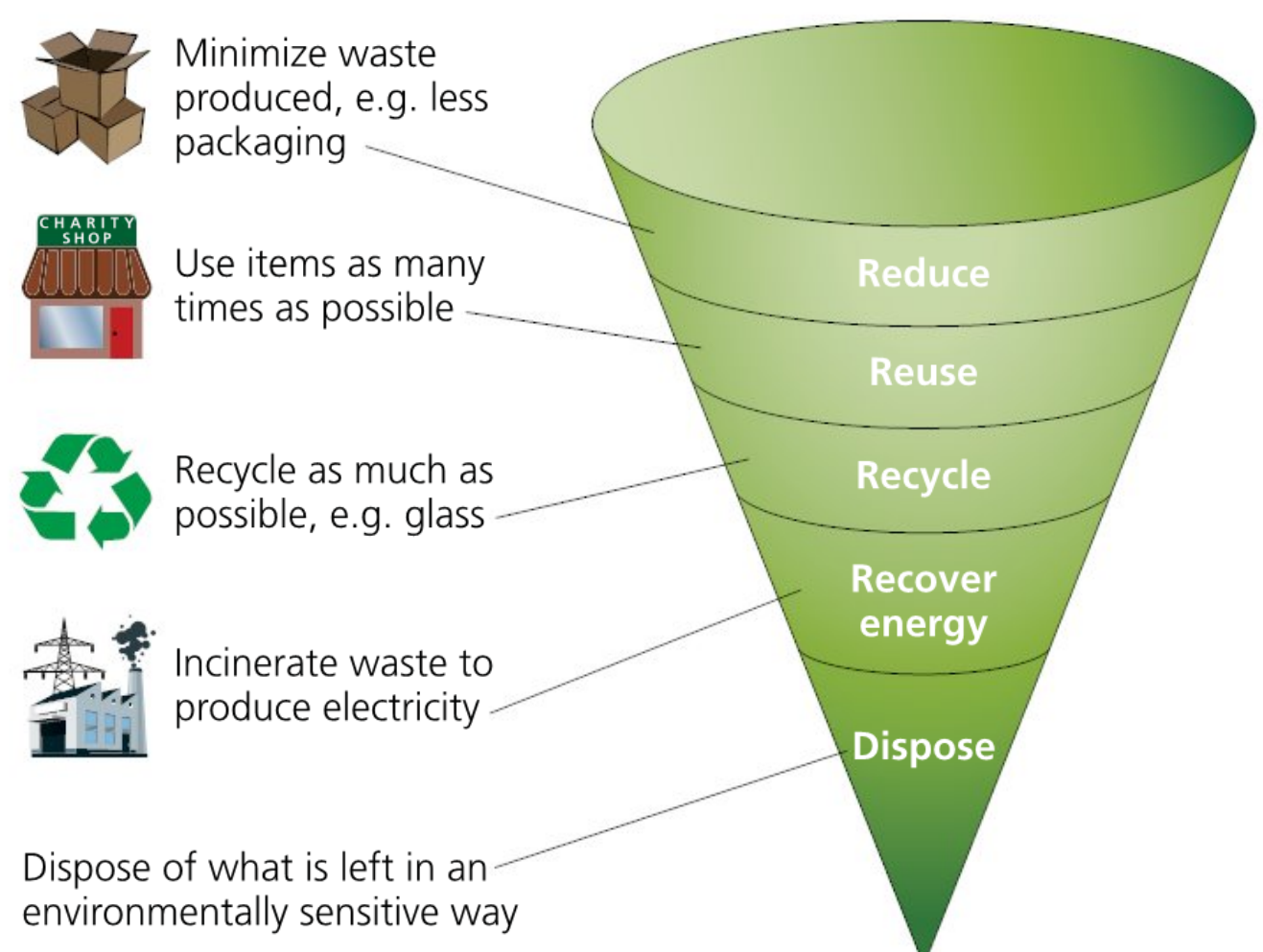
■ **Table 5.9** Which word is the odd one out?

Conservation is using natural resources carefully to make sure they can satisfy the needs of current generations without compromising the needs of future generations. Countries need to manage the supply and demand of resources in order to achieve sustainability through their development. This is a real challenge for governments, decision-makers and **stakeholders** as progress can only be made providing there is societal change in terms of individual values, behaviour and decisions on the importance of conservation. Globally, there is also growing pressure for an equitable share in the use of natural resources, which requires international effort and management. So, what can be done to help conserve natural resources?

You have already learnt that non-renewable resources are finite and that they only get replaced over geological timeframes. Our current non-renewable resource consumption rate is such that these resources will eventually run out (see Figure 5.35).



A good example of a conservation strategy is called the 'three Rs'. This resource management strategy aims to *reduce* the amount of waste produced and to extend the life of certain products by encouraging consumers to buy fewer items they do not need and to *reuse* those they have already purchased or that have been purchased by others. *Recycling* comes as the third step in the process, with disposing being the last resort at the bottom of the waste hierarchy 'reversed' pyramid (see Figure 5.36). Over the past decade, many new upcycling businesses have thrived, such as US-based Hipcycle or Spanish company Ecoalf, which recycles discarded fishing nets collected from the oceans (see Figure 5.37). Recent commercial success from upcycling and recycling comes as a result of people wanting to consume more ethically and responsibly.



■ **Figure 5.36** The waste hierarchy



■ **Figure 5.37** Recycling and upcycling clothing brand Ecoalf

The challenge for the conservation of renewable resources is to limit the amount of extraction. Natural resources such as fish populations, forests and soil can only be maintained at renewable levels if the rate of exploitation does not exceed the regeneration rates of these resources. Various solutions have been implemented by intergovernmental organizations such as the United Nations and trading blocs like the European Union (EU). **Quotas** are often used when several countries agree to limit the exploitation of certain resources. A good example of this is the EU's Common Fisheries Policy (see Figure 5.38).

DISCUSS

In 1833, Victorian economist William Forster Lloyd published an essay in which he used the analogy of the common land in an English village to explain the issue of overuse of shared resources. He explained that each herder in a village, who was traditionally entitled to let his cattle graze the common land, could damage the resource for the whole village just by satisfying his own needs. The grazing land in the 'commons' could become a limited resource by overgrazing if left unregulated and unchecked. His theory later became known as the 'tragedy of the commons'.

In pairs, **discuss** the extent to which the concept of the tragedy of the commons is applicable to the Earth's natural resources. Can you think of any shared common resources that are under the threat of depletion or extinction because of over use?

The new Common Fisheries Policy: sustainability in depth



What?



MSY

Maximum Sustainable Yield is the best possible objective for renewable and profitable fisheries, harvesting the maximum amount of fish on a long term basis.



Regionalisation

Natural resources and the socioeconomic fabric vary greatly from one place to another. A balanced representation of local stakeholders knows best how to apply EU rules in their respective areas.

$$C = \frac{F}{F+M} [1 - e^{-(F+M)T}] N_0$$

Fisheries science

Scientific advice is the basis for good policy making, setting fishing opportunities according to the state and productivity of fish stocks.



Multiannual plans

Contain the goals and tools for fish stock management and the roadmap to achieving the objectives in a sustainable and inclusive way.

How?



Rules

Because fishing is an activity that exploits common natural resources, it needs to be regulated to safeguard fair access, sustainability and profitability for all.

- Total Allowable Catches
- Fishing licenses
- Boat capacity management
- Reducing environmental impact

- Minimum fish and mesh sizes
- Design and use of gears
- Closed areas or seasons



Discards

The landing obligation (to be gradually introduced from 2015 to 2019), prohibits this wasteful practice and will provide more accurate data on real catches, and will be a driver for more selectivity and better planning.



Targeted funding

For low impact, small scale local fleets: important for employment, marine stewardship and holding together the coastal communities.



Aquaculture

With wild fish no longer able to supply the world population, sustainable aquaculture is called to meet the growing demand for seafood.



Control

Good management relies on awareness, compliance and enforcement. Sufficient and reliable data must be collected, managed and supplied by Member States.

■ **Figure 5.38** The EU's Common Fisheries Policy

▼ Links to: History

Research how the 'tragedy of the commons' concept has evolved over time. Are there any historical events that have helped to test the theory regarding the relationship between resources and population and therefore modelled our contemporary understanding of the concept?

CASE STUDY – THE EU'S COMMON FISHERIES POLICY

Unlike rich countries, poor countries do not have to be convinced about the benefit of the 'three Rs'. There is a well-established culture of reusing and recycling in many developing parts of the world as most people cannot afford to buy new replacement products. Sometimes, recycling constitutes a major source of income for the poorest section of the society, as in the landfill site of Bantar Gebang in Jakarta, Indonesia. About 3,000 families live and work on the largest waste dump in the country where 9,000 tonnes of rubbish arrives each day. The sustainability management issue for countries like Indonesia is how to deal with the amount of waste and with the health and environmental impacts of uncontrolled waste disposal.

DISCUSS

Study Figure 5.39. In pairs, **discuss** why you think so many people can make a living from searching for recyclable waste in a country like Indonesia.



■ **Figure 5.39** The Bantar Gebang waste dump in Jakarta, Indonesia

CASE STUDY: Investigating SDG 12: Ensure sustainable consumption and production patterns

■ ATL

- Critical-thinking skills: Analyse complex concepts and projects into their constituent parts and synthesize them to create new understanding

Explore solutions and innovations for turning supply chains, production systems and resource consumption into more sustainable and responsible systems.

You will focus on examples from the EU and write them as a case study.

Visit this website that presents the European Commission's strategies for achieving UN Sustainable Development Goal 12: https://ec.europa.eu/sustainable-development/goal12_en

In groups of four, each person should choose a different strategy from targets 12.2 to 12.6 (see the page contents on the web page). Each group member should then record their findings in a copy of Table 5.10.

New strategy	Detail	Reason for this strategy	Impact on sustainability

■ **Table 5.10** Strategy details

Share your findings as a group. Each member should then add these findings in three extra rows in their table.

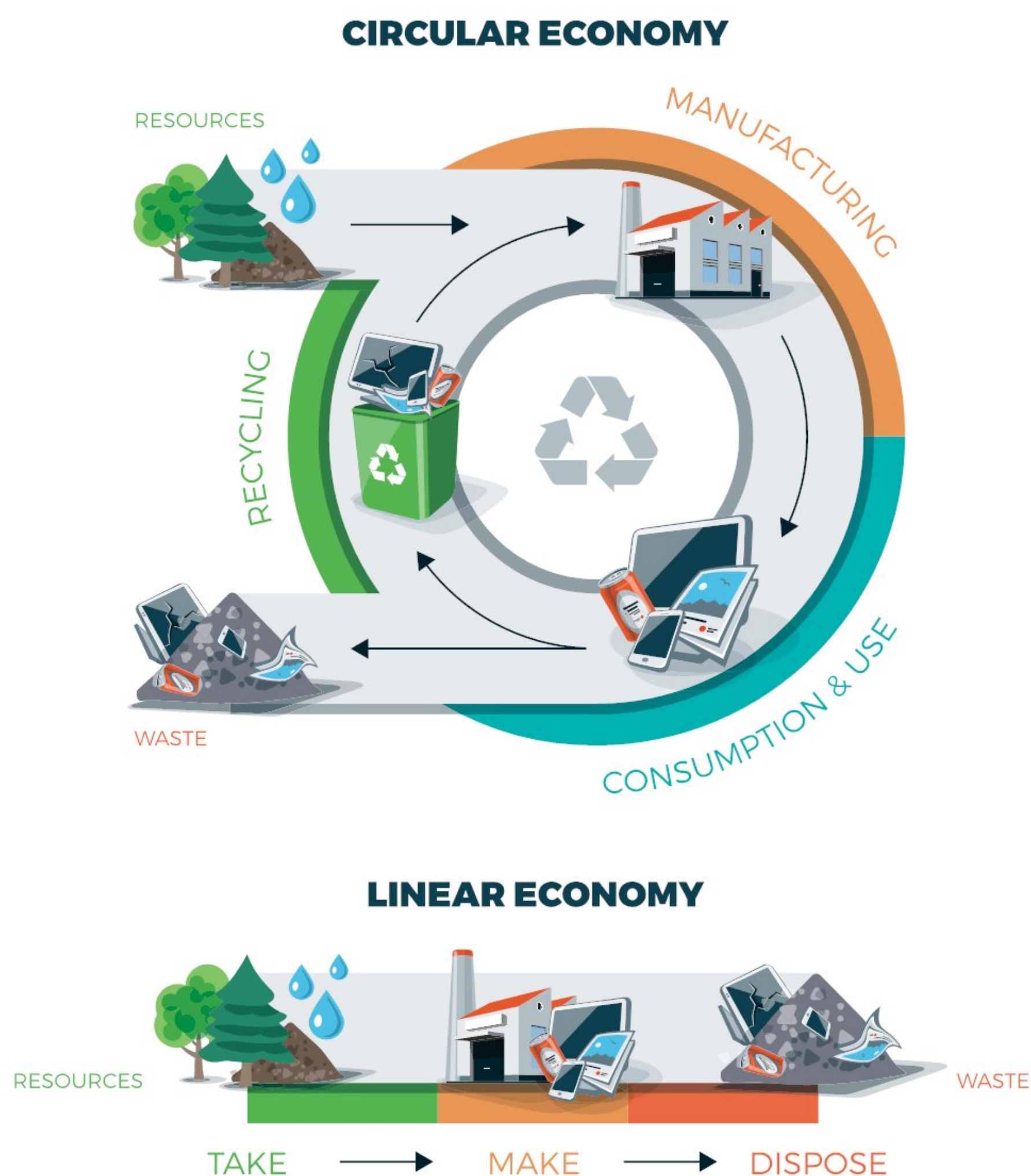
As a group, **find** at least four more strategies from within the class that were not covered by your group. Try to **find** examples from as many different targets as possible.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding.

How is the circular economy making production systems more sustainable?

The circular economy is a concept that first appeared in the 1970s through the work of researchers for the European Commission. More recently it has found wider public exposure through the work of the Ellen MacArthur Foundation. The principle is that for the economy to be sustainable it should be organized like the Earth's living systems. In the *MYP Sciences by Concept* books, you may have learnt about the interdependence of the components in a natural ecosystem. Our world is also interconnected: the economy, society and the environment are all interdependent and must work as part of a system if the world is to be sustainable. The circular economy operates as a loop (see Figure 5.40). The inputs are minimum; the flows of resources, energy, technologies and information are designed as a continuous system maximizing energy use and minimizing waste through recycling and reusing material. The whole system adds value to the economy and to people's lives. It is in complete contrast with the linear economy model which has underpinned the world economic growth since the mid-twentieth century.



■ **Figure 5.40** Circular and linear economies

▼ Links to: Sciences

Discuss the role played by scientific knowledge of the Earth's natural ecosystems in shaping the circular economy principle. How have different fields within science contributed to this debate?

! Take action: Advocating the circular economy model

■ ATL

- Critical-thinking skills: Evaluate evidence and arguments
- Collaboration skills: Build consensus
- Communication skills: Use a variety of media to communicate with a range of audiences

What is your goal?

- ! Your goal is to communicate the benefits of the circular economy as an advocate. You will have to **select** your target audience and adapt your presentation format accordingly.

How will you organize your project?

- ! Task 1: Brainstorm the key concepts and key terminology you will need to cover in your piece. Don't forget to include a clear reference to the circular economy model as shown in Figure 5.40. Look back at pages 114–18 from this chapter for help.
- ! Task 2: Research your information, making sure you focus on two or three good examples of business models or companies that encompass the circular economy model. You could start your research with the Ellen MacArthur Foundation website: www.ellenmacarthurfoundation.org/circular-economy/interactive-diagram

- ! Task 3: Choose the most appropriate format for your target audience. Use RAFT (see below) to help you plan your work. Try to target a wider audience than just your class. You could aim your piece at a local elementary or primary school, in which case a poster might be an appropriate method for presenting your work. If you are going to **present** your work to high school students, you could make connections to Sustainable Development Goal 12 and elements of the CAS element of the IB.
- ! Task 4: Once you have presented or shared your work, **evaluate** its impact. You could **design** a survey, get some feedback through peer evaluation or conduct a question and answer session. Consider the following:
 - ◆ What has your audience learnt from you?
 - ◆ Have they changed their minds about how impactful consumer products might be?
 - ◆ Will your audience consider changing the way they consume or shop?

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding, Criterion B: Investigating and Criterion C: Communicating.



Using the RAFT technique

The RAFT technique is designed to help you consider your role as a writer, the audience you will address, the various formats for writing, and the expected content.

- **Role of the writer:** Who are you as a writer? Consider who you are pretending to be.
- **Audience:** Consider to whom you are writing.
- **Format:** Consider the form of communication you will use. Are you writing to persuade, entertain, inform, or describe?
- **Topic:** What are you writing about? What is the subject or the point of your piece?

How can individual consumers make a difference?

DISCUSS

What is the message of the cartoonist in Figure 5.41?



■ **Figure 5.41** Modern world caricature © Steve Cutts

Sustainable economic growth can only be attained if the exploitation of natural resources for the production of goods and services can accomplish both environmental sustainability and an improvement in the quality of people's lives. Sustainability and development require a managed use of natural resources with strict rules on minimizing resource use and on controlling the waste and pollution generated throughout the entire supply chain.

One way to achieve this is to implement the UN SDG 12. This goal requires countries to develop strategies for sustainable consumption and production, and sustainable business practices and consumer behaviour. In October 2015,

India committed to reducing its greenhouse emissions by 20–25 per cent from its 2005 levels by 2020 and by 33–35 per cent by 2030. The National Policy on Biofuels and the National Clean Energy Fund are some of the measures the government put in place to achieve its own SDG 12 (see Figure 5.42). At the international level, rules and regulations would have to be enforced to reduce waste and the impacts from pollution. India formally agreed to the historic Paris Agreement in October 2016.

In the following activities you will be able to take action to find the best solutions for reducing resource consumption at global and local scales.



■ **Figure 5.42** The sustainable development challenge for India

SOLUTIONS FOR REDUCING RESOURCE CONSUMPTION AT GLOBAL AND LOCAL SCALES

ACTIVITY: Action plan for a new corporate policy

■ ATL

- Creative-thinking skills: Create novel solutions to authentic problems
- Communication skills: Negotiate ideas and knowledge with peers and teachers

Task

You and your partner work for a large US consumer electronics multinational which outsources most of its components from China. You have been asked by the company CEO to join the business development team to help them work on future key challenges:

- The company's customer surveys show a growing desire for more ethical and sustainable products.
- Social media trends show that millennials see sustainability as a shopping priority.
- There is growing pressure from international organizations like the UN and multilateral organizations like the EU to impose regulations for achieving SDG targets.

Requirements

You need to draft a new corporate policy which clearly addresses as many targets as possible from SDG 12, as

shown here: <https://sustainabledevelopment.un.org/sdg12>. (Click on the *Targets & Indicators* tab.)

Format

The policy should be written as a **list** of statements making clear reference to target numbers.

Hint

Make sure you only address targets that are relevant to your business and your products.

Your policy is an internal draft document for submission to the CEO. You therefore need to include pros and cons for each statement so they can be discussed during executive board meetings.

Join another pair and, as a group of four, **discuss** the pros and cons of the policy from each pair.

Return to your pair. Amend your policy based on the feedback received during the discussion.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion C: Communicating and Criterion D: Thinking critically.

! Take action: A consumer guide for local and sustainable shopping

■ ATL

- **Collaboration skills:** Encourage others to contribute; Take responsibility for one's own actions
- **Communication skills:** Use a variety of media to communicate with a range of audiences

- ! **Create** a consumer's guide to locally and sustainably produced goods and services. You need to come up with a compilation of the best stores, food outlets and services that sell or use sustainable, energy-efficient and locally sourced products in a location near you.
- ! **Work in groups.** Each group member should take an active role in each of the investigation steps as shown in the fieldwork inquiry graphic organizer (Figure 5.43).
- ! You could undertake a small local fieldwork investigation. For this, you should work in groups in order to make the primary data collection more time efficient and effective.
- ! **Present** your findings in a format of your choice. Make sure you clearly communicate the best places for local and sustainable shopping.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion B: Investigating, Criterion C: Communicating and Criterion D: Thinking critically.



■ **Figure 5.43** Fieldwork inquiry graphic organizer

Reflection

In this chapter, we have **described** the global pattern of resource production and consumption, and **explained** the role of international corporations in resource extraction and consumption. We have **analysed** the link between income levels and the rate and types of resource consumption. We have **investigated** the environmental impacts of global production and consumption of resources. We have **outlined** the role of the circular economy in achieving sustainable development and **summarized** the solutions for dealing with unsustainable levels of resource exploitation and consumption. We have **taken action** to find the best solutions for reducing resource consumption at local and global level.

Use this table to reflect on your own learning in this chapter.					
Questions we asked	Answers we found	Any further questions now?			
Factual: What is the world pattern of resource production and consumption? How is the supply chain of products organized? What are the environmental impacts of global resource production and consumption? How can sustainable levels of resource extraction, production and consumption be achieved?					
Conceptual: How do global interactions influence the production and consumption of resources? How is the circular economy making production systems more sustainable?					
Debatable: Are global consumption levels sustainable? How can individual consumers make a difference?					
Approaches to learning you used in this chapter:	Description – what new skills did you learn?	How well did you master the skills?			
		Novice	Learner	Practitioner	Expert
Collaboration skills					
Communication skills					
Creative-thinking skills					
Critical-thinking skills					
Information literacy skills					
Media literacy skills					
Reflection skills					
Transfer skills					
Learner profile disposition	Reflect on the importance of being a good inquirer for your learning in this chapter.				
Inquirer					

6

How can biomes be managed for all to benefit?

- **Changes** in the **processes** within different biomes can be **managed sustainably** for **all to benefit**.

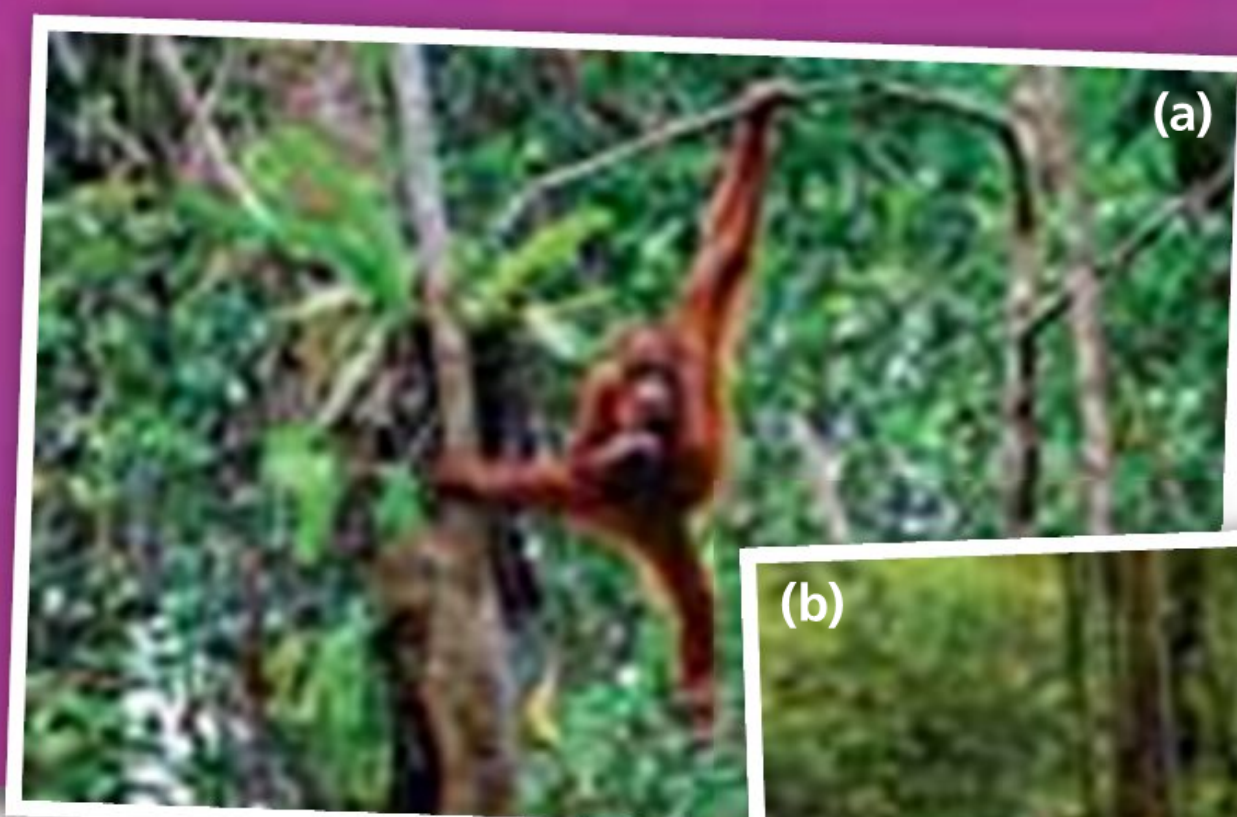
CONSIDER THESE QUESTIONS:

Factual: What are biomes and where are they located? What are the main factors affecting biome location?

Conceptual: What are the main processes in a biome? How have plants and animals adapted to their biomes? How have indigenous people adapted to their biomes? What changes are caused by the management of biomes?

Debatable: Is it possible for management of biomes to be sustainable and equitable?

Now **share and compare** your thoughts and ideas with your partner, or with the whole class.



■ **Figure 6.1** (a) An orangutan in the tropical rainforest, (b) an eco-forest for tourism in Costa Rica, (c) an oil pipeline in the Alaskan tundra, (d) tourists on safari, (e) a mountain ski resort, (f) wetland mangrove

○ IN THIS CHAPTER, WE WILL ...

- **Find out** how indigenous people, animals and plants have adapted to the climate.
- **Explore** how biomes have been exploited for their resources.
- **Take action** by raising awareness of exploitation of biomes and the people living in them and of how to be a sustainable consumer when buying products such as palm oil.



■ These Approaches to Learning (ATL) skills will be useful ...

- Communication skills
- Critical-thinking skills
- Information literacy skills

● We will reflect on this learner profile attribute ...

- Principled – we will explore the importance of fairness for all when managing different biomes.

◆ Assessment opportunities in this chapter:

- ◆ **Criterion A:** Knowing and understanding
- ◆ **Criterion B:** Investigating
- ◆ **Criterion C:** Communicating
- ◆ **Criterion D:** Thinking critically

SEE–THINK–WONDER

Look at Figure 6.1. What do you see? What do these photos make you think? What do they make you wonder?

THINK–PUZZLE–EXPLORE

Think: What do you think you know about this topic?

Puzzle: What questions or puzzles do you have?

Explore: How can you **explore** this topic?

Discuss your answers in small groups and then share with the rest of the class.

In *MYP Individuals & Societies by Concept 2* you may have looked at how natural environments are critical to individuals and societies. Ecosystems come in different scales from the smallest (a niche) to the largest (a **biome**). All nonliving (**abiotic**) and living (**biotic**) things interact, and different processes work together to form life in different places. Humans are part of this system, and we have changed the interactions within many biomes, sometimes with negative consequences.

In this chapter, we will be **exploring** the factors affecting biome location, considering the primary processes that take place within them, and how and why these processes are different. We will be **investigating** how plants, animals and people have adapted to different biomes and how the environment has been exploited in the past and is being exploited now. We will also be **developing** our ideas of what makes a fair and sustainable management programme.

KEY WORDS

abiotic	fauna	latitude
altitude	flora	nutrient cycle
biome	food chain	trophic level
biotic	food web	
climate	indigenous	

What are biomes and where are they located?

Biomes are classified by the type of vegetation and **climate** and are found all over the world. They are the largest area on the ecosystem scale. Terrestrial biomes can cover vast parts of a continent, while aquatic biomes can be whole regions of a sea or ocean.

You will be focusing on two types of biome: rainforest and savanna. You will have an opportunity to research another type of your choice for your summative assessment.

Biomes are large areas that have the same/similar types of vegetation and animal life. A particular type of biome tends to be located in similar areas, but can be found in different parts of the world. For example, rainforests are not confined to the Amazon, but stretch across the globe to Africa and Asia.

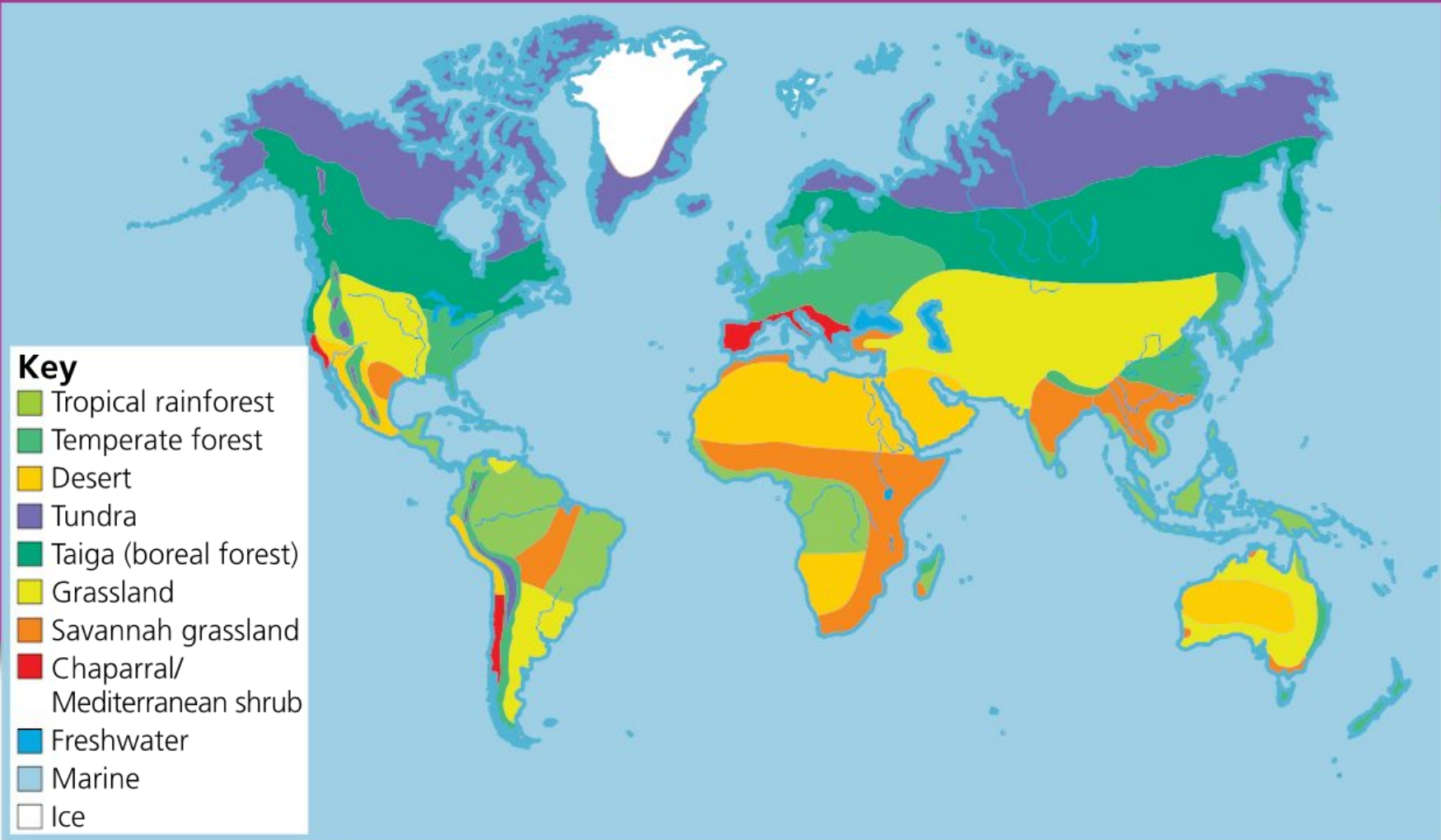


Figure 6.2 World biomes

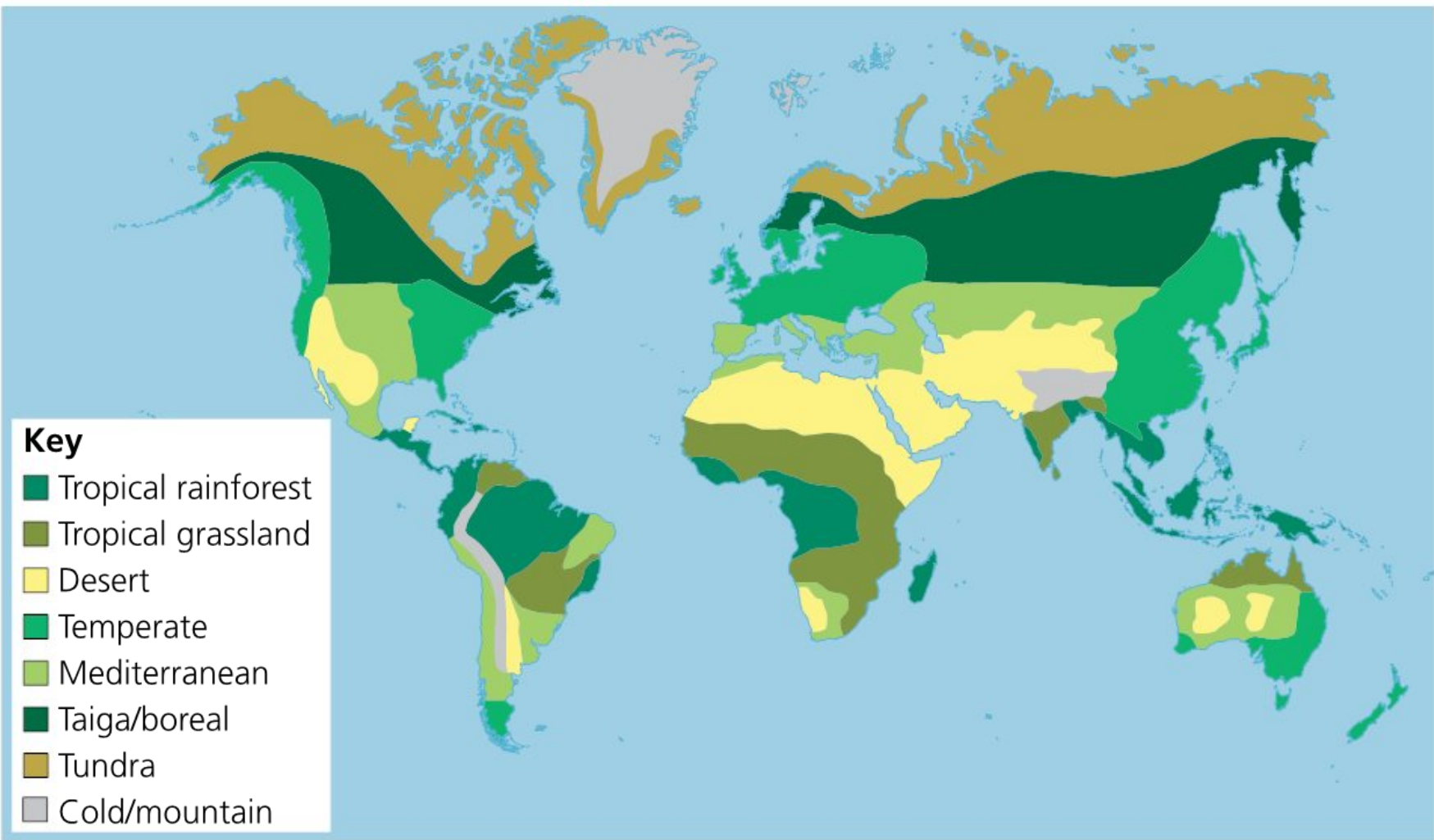


Figure 6.3 Global climate zones

ACTIVITY: What and where are the biomes?

- ATL
- Communication skills: Organize and depict information logically

In pairs, and without doing any research, think about the different types of terrestrial and aquatic biomes. Try to locate them and **suggest** reasons for their location. Share your ideas with the rest of the class and **compare** your examples. Either as a group or on your own, copy and complete Table 6.1.

Biome	Location	Reasons for your choice of location

Table 6.1 Biomes and their locations

Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding.

ACTIVITY: Biomes and climate location

■ ATL

- Communication skills: Organize and depict information logically

On a world outline map, and using Figure 6.2, mark the locations of the biomes. **Describe** in detail the locations of the main biomes.

On another world map, or using tracing paper, mark the main global climate zones from Figure 6.3. Look carefully at the two maps you have drawn and **discuss** your findings.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding.

How to describe a world map

Use country names, cities and **latitude** to help you with your description.

How to read climate graphs

See *MYP Individuals & Societies by Concept 2*, page 37, for more on how to read climate graphs and what they represent.

Climate is the average temperature (measured in °C) and precipitation (mm), taken over 40 years or so. Climate graphs are used to see the pattern of temperature and precipitation for a specific place over a year.

Figures 6.4 and 6.5 show two different climate graphs, one for an equatorial climate, which is where the tropical rainforest biomes are found, and the other for savanna grasslands, which are found north and south of the tropical rainforests. On the graphs, the red line shows the temperature and the blue bars show precipitation; these are indicated on the y-axis. The x-axis shows the months of the year. The average temperature and total precipitation for the year can be **calculated** from the graphs.

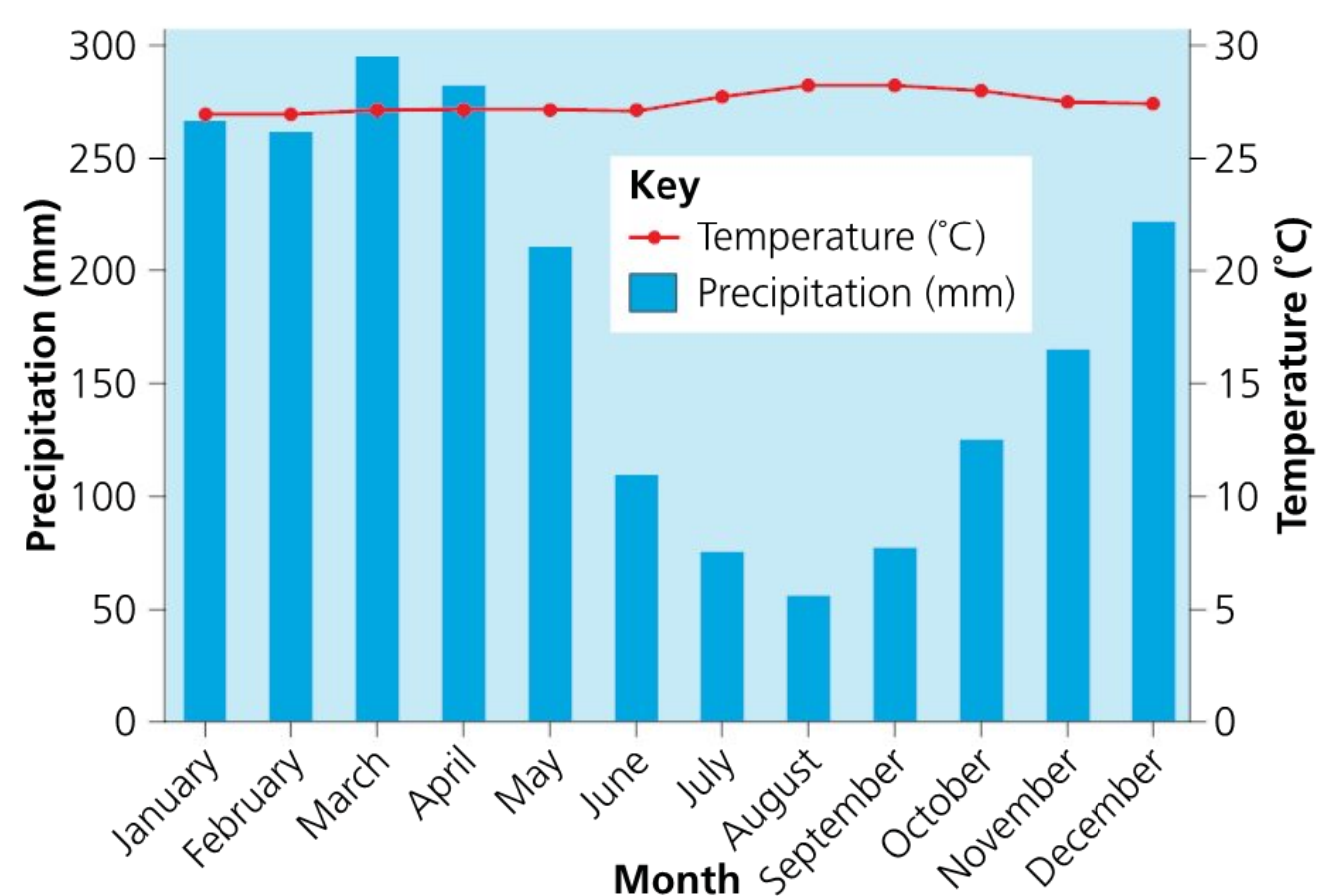
ACTIVITY: Reading climate graphs

■ ATL

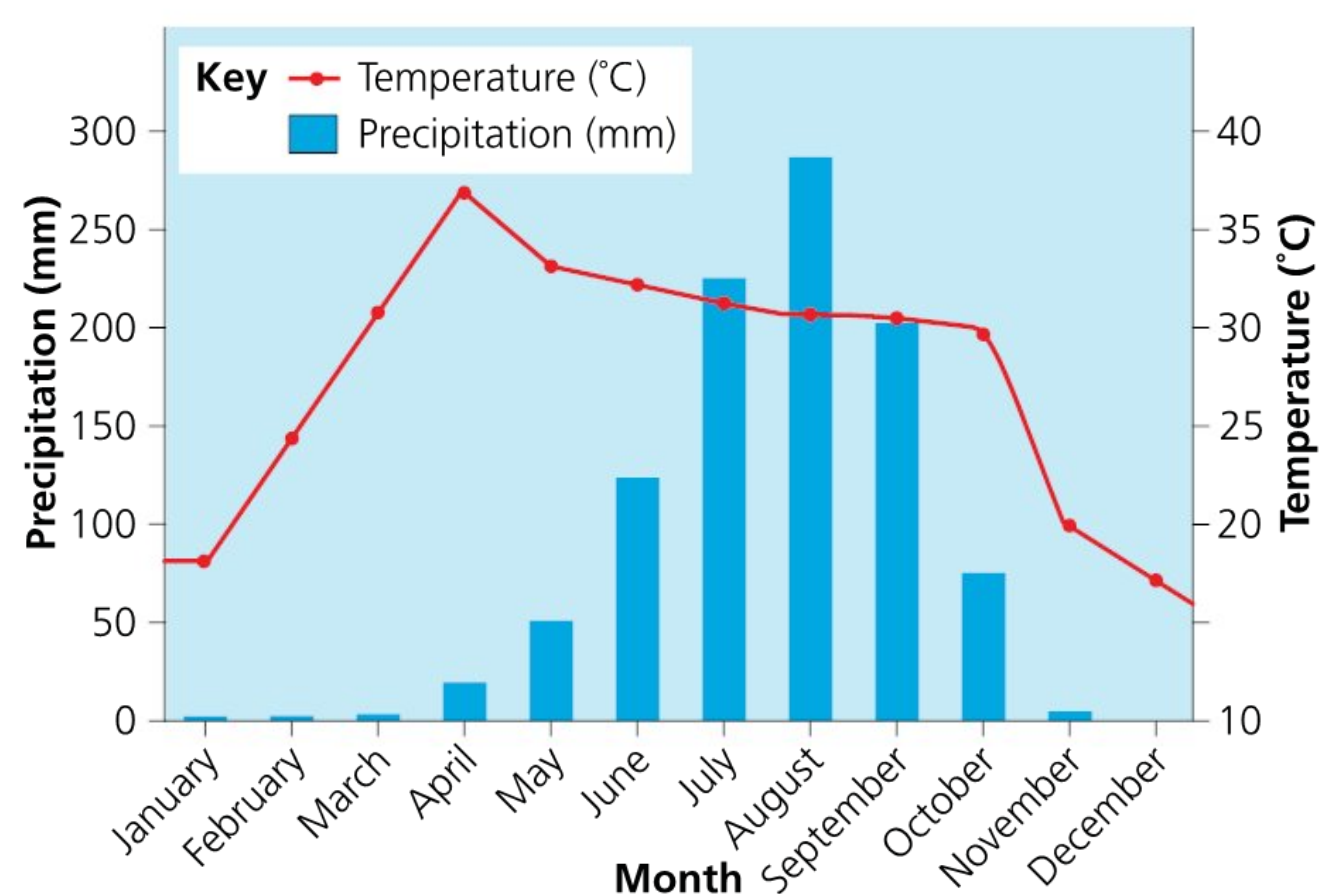
- Critical-thinking skills: Interpret data

Compare and contrast the two climate graphs in Figures 6.4 and 6.5.

- **Describe** each climate graph by temperature and rainfall.
- Which months have the highest rainfall and which months have the highest temperature?
- Which months have the lowest rainfall and which months have the lowest temperature?



■ **Figure 6.4** Climate graph for a tropical rainforest



■ **Figure 6.5** Climate graph for savanna grasslands in the northern hemisphere

What are the main factors affecting biome location?

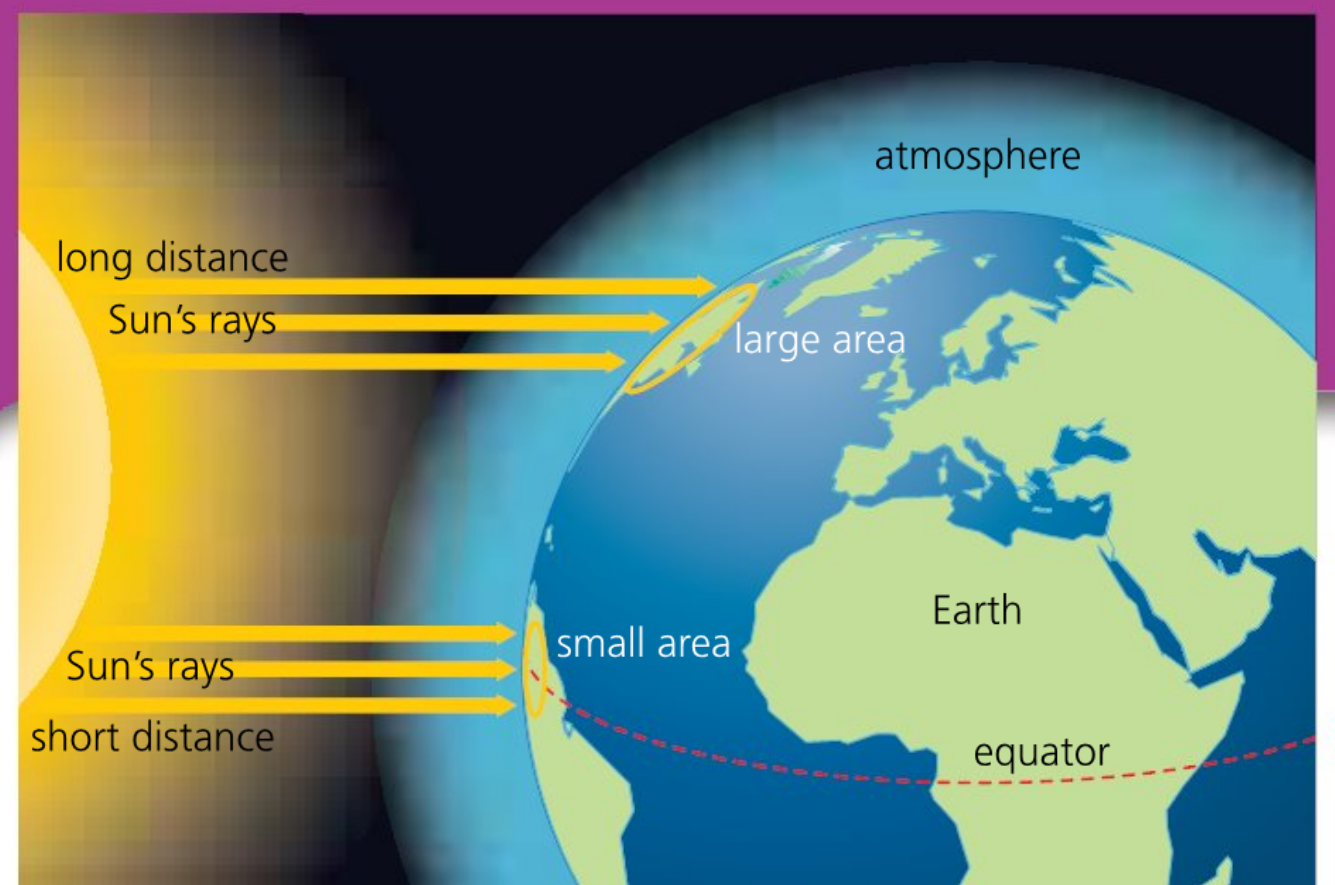


Figure 6.6 The angle of the Sun at the equator, the tropics and the poles

There are many reasons why biomes are located in specific areas. Their location is linked both to large-scale, global climate areas, and smaller local differences, such as **altitude** and proximity to the sea or ocean. On a global scale, latitude is one of the most critical factors as this affects the amount of the Sun's energy a region gets, which then links to other factors such as air pressure cells.



Figure 6.7 (a) Tropical rainforest, (b) savanna grasslands, (c) desert, (d) prairie grasslands, (e) mountain/alpine, (f) deciduous forest, (g) coniferous forest, (h) tundra

THINK-PAIR-SHARE

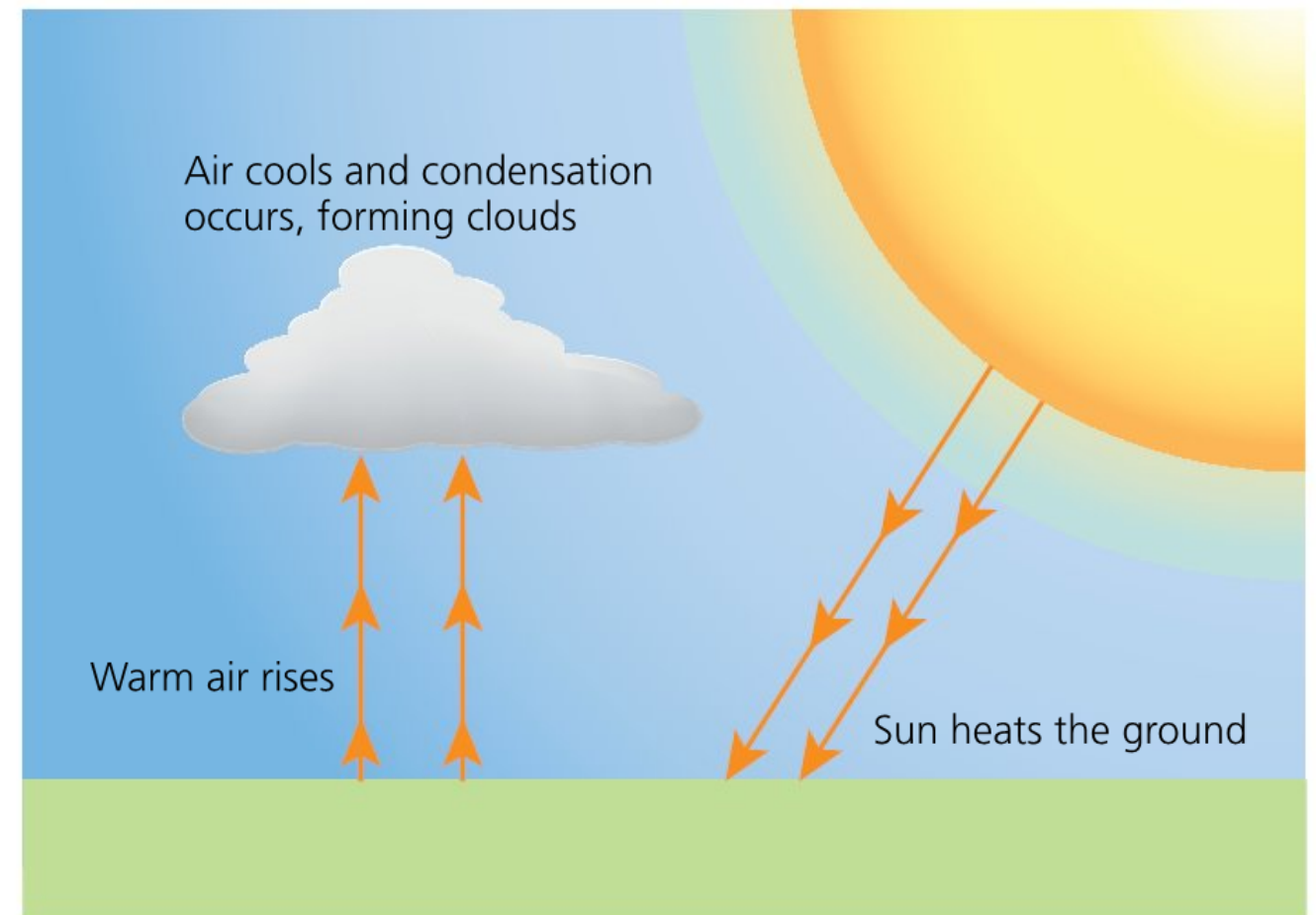
Look at the world map (Figure 6.3), the angle of the Sun (Figure 6.6) and the photos of the different biomes (Figure 6.7). Can you **suggest** any reasons for the type of vegetation that occurs in each biome?

THE SUN

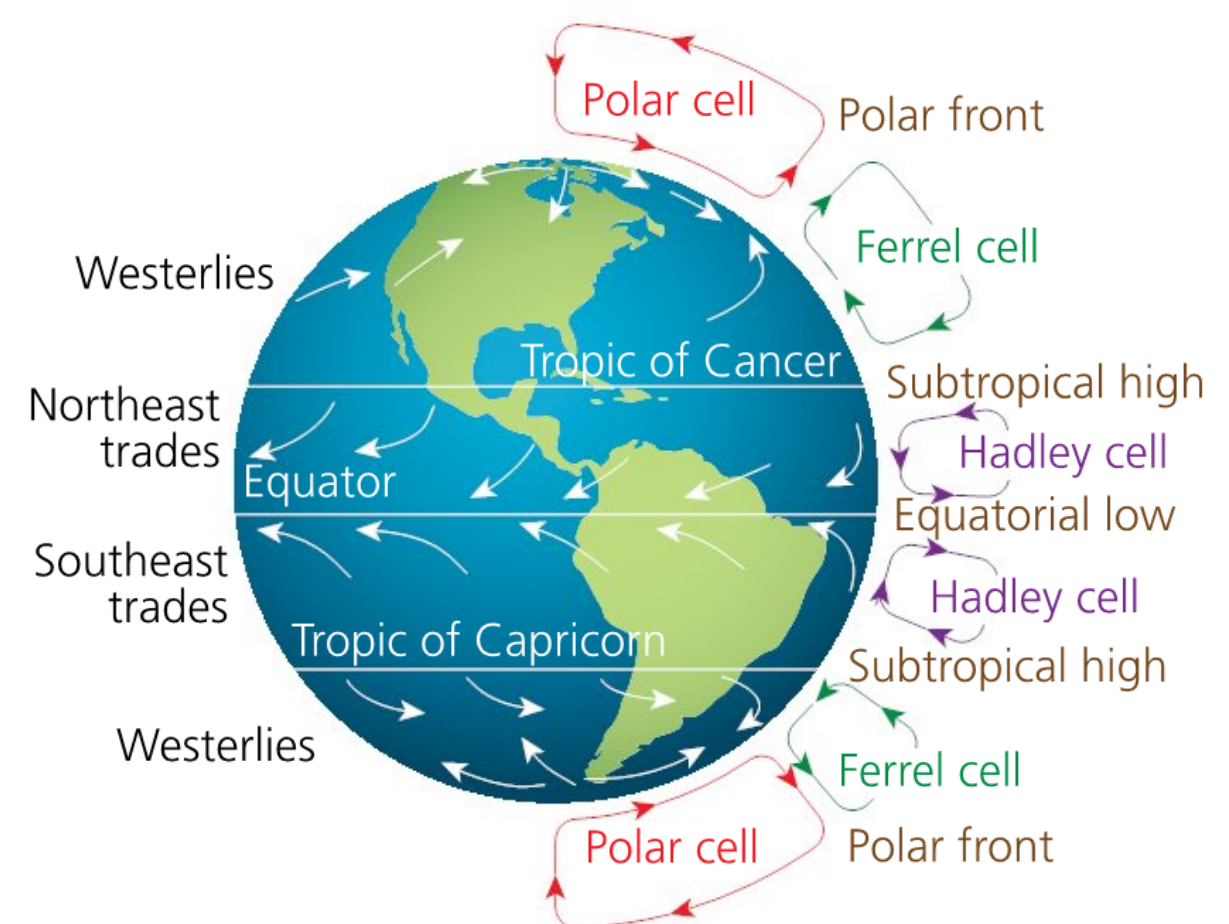
The amount of the Sun's energy (solar energy) and precipitation depends on how far north or south you travel from the equator. The world map (Figure 6.6) shows the angle of the Sun at the equator compared to the poles. The same amount of energy covers a smaller area of land over the equator, while at the poles the angle is much greater and the energy is spread over a larger area of land. It is therefore warmer at the equator than at the poles. This heat energy also affects the pressure cells/belts that bring precipitation around the globe. The Intertropical Convergence Zone (ITCZ) (see Figure 6.10) is an air pressure belt/cell that is heated up throughout the year. This belt brings a warm and wet climate, with high levels of precipitation, around 2,000 mm a year, because it is an area of low pressure. This low-pressure cell brings convective rain (see Figure 6.8) and hot weather to the equatorial region all year round. The environment is also very humid due to the high evapotranspiration. As you move away from the equator, you come to a high-pressure cell. In regions of high pressure, the air tends to descend, and very little evaporation and therefore condensation occurs, so there is little precipitation. Figure 6.9 shows these different pressure cells.

DISCUSS

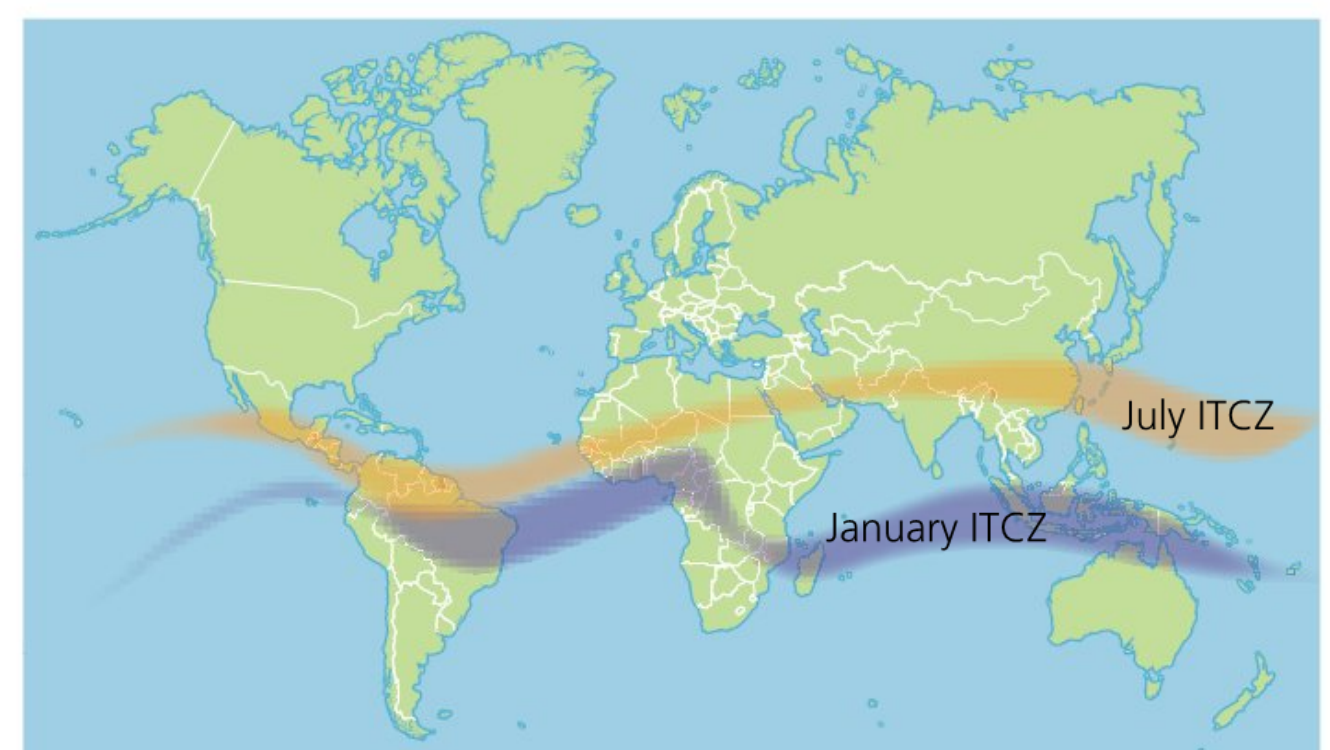
Using the photos in Figure 6.7 (a) and (b) of the tropical rainforest biome and the savanna biome and Figure 6.9, **discuss** how the rainforest and the savanna grasslands both have hot temperatures, but very different amounts of rainfall.



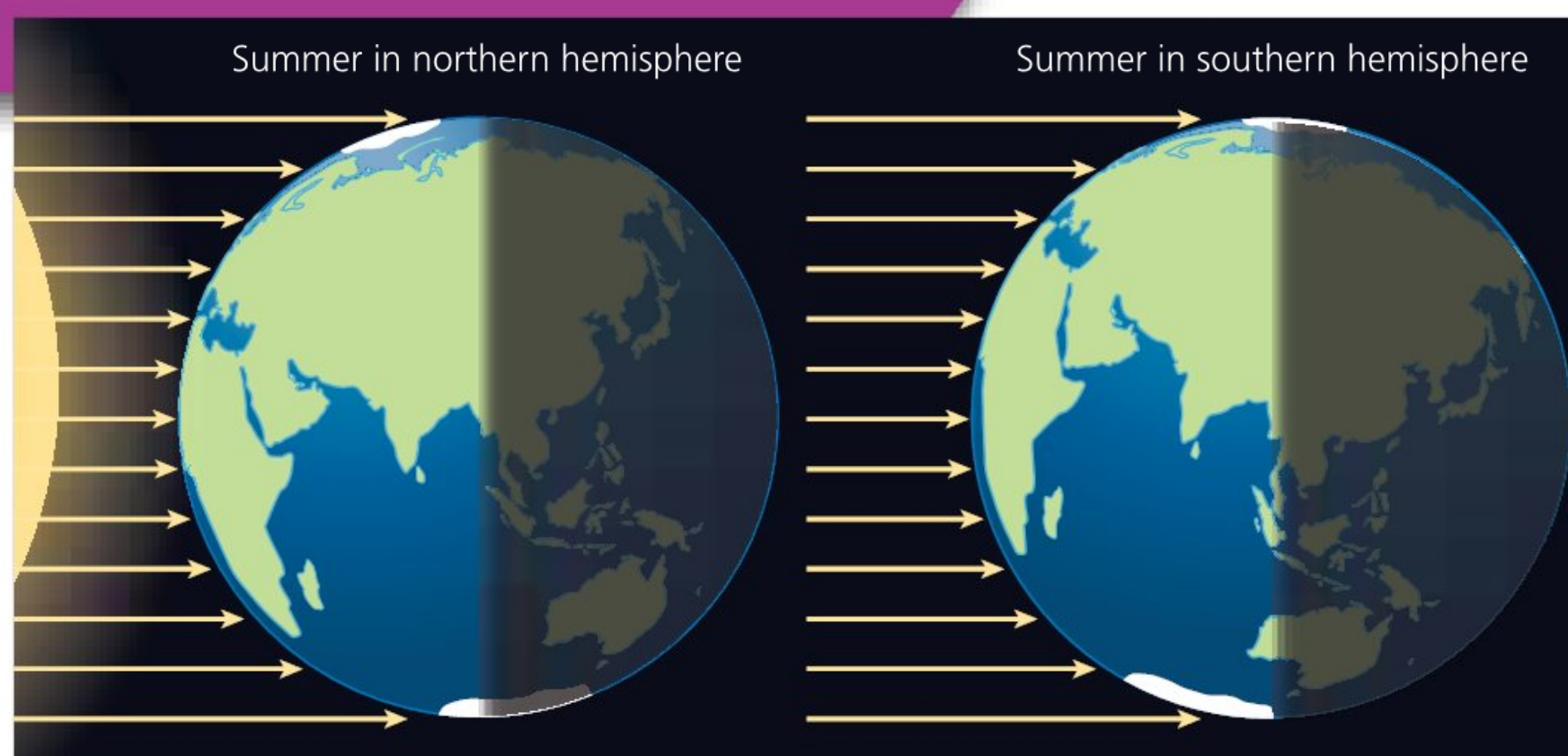
■ **Figure 6.8** Convective rainfall



■ **Figure 6.9** Global atmospheric pressure cells



■ **Figure 6.10** Movement of the Intertropical Convergence Zone from July to January



■ **Figure 6.11** The four seasons

The angle of the Sun is not quite as shown in Figure 6.6. The planet is tilted at 23.5 degrees relative to our **orbital plane**; this means the overhead Sun is not at the same point throughout the year. This axial tilt is the reason why the northern hemisphere has different seasons from the southern hemisphere, and it also affects the pressure cells/belts, which in turn affect the amount of precipitation in some regions around the globe, and this will affect the biome.

Have you ever heard of the terms 'equinox', 'summer solstice' and 'winter solstice'? You may not have done if you live near the equator and the tropics; this is because with the Sun almost 90 degrees overhead all year, there are very few seasonal changes to the climate – the temperature and precipitation are pretty much the same each month. The further north or south you travel from the equator, the more change there is in temperature and precipitation over the months – and therefore there are seasons. An example of this is in Europe, where there are (typically) four seasons: winter, spring, summer and autumn (fall). The times of the year for the seasons are different between the northern and southern hemisphere. In the northern hemisphere, spring starts around 21 March, and autumn (fall) starts around 21 September; the lengths of day and night at these times of year are the same at 12 hours each (hence the term 'equinox'). Around 21 June, the northern hemisphere has the longest day of the year (called the summer solstice), but in the southern hemisphere, this is known as the winter solstice, as the shortest day occurs then. Of course, the opposite happens six months later on 21 December. What has this to do with biomes? The changes of the seasons bring differences in temperature and precipitation and therefore influence the types of vegetation that will grow.

ACTIVITY: How does the season affect the climate and biomes?

■ ATL

- Critical-thinking skills: Gather and organize relevant information to formulate an argument

Study Figures 6.6, 6.10 and 6.11, showing the changes in the angle of the overhead Sun throughout the year and the air pressure belts/cells and the changes in the seasons.

Investigate the vegetation, climate graphs and seasons in savanna grasslands in both Kenya and South Africa.

Country	Location	Climate similarities	Climate differences	Plant growing season similarities	Plant growing season differences
Kenya					
South Africa					

■ **Table 6.2** Savanna grasslands in Kenya and South Africa

When you are describing climate, remember to think in terms of annual total rainfall and the pattern throughout the year (Are there any dry seasons? Does it rain all year?), annual temperature range and diurnal (daily) temperature range (Does the temperature remain the same throughout the year, or does it change? Are there small changes in temperature during the day, or one big change?).

Copy and complete Table 6.2 to **describe** the similarities and differences between the two countries with the same biome.

Underneath your table, **explain** the reasons for the similarities and differences.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding, Criterion B: Investigating and Criterion D: Thinking critically.

Biome location does not depend solely on latitude, but also other factors, including local conditions, such as altitude. For example, Mount Kenya is located on the equator, but pictures always show the peak covered in snow. This seems to contradict what we have learnt about there being more solar energy at the equator, but is due to the fact that the higher you go up a mountain, the lower the temperature drops, in fact by 1 °C every 100 m throughout the **troposphere**

OCEAN CURRENTS

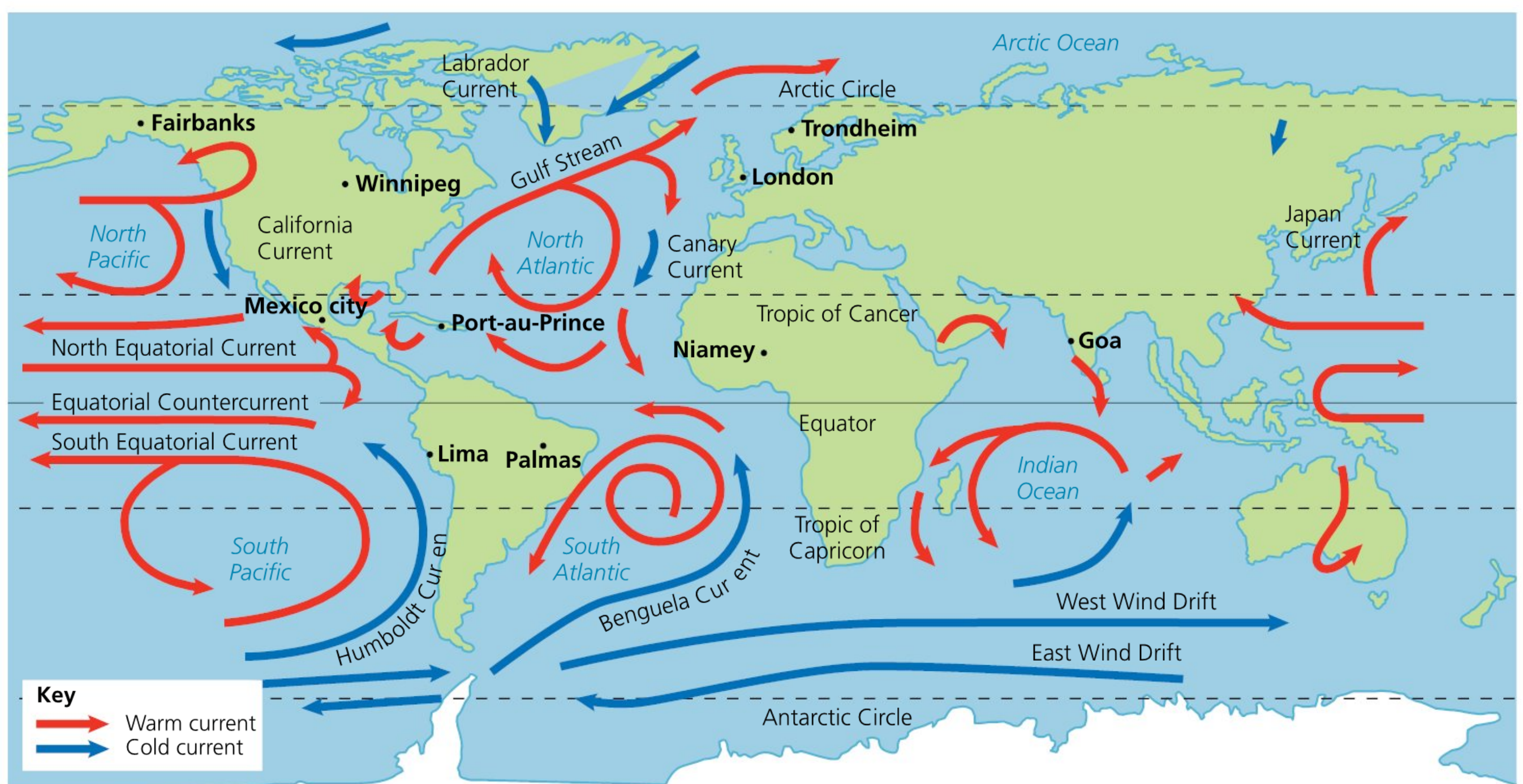
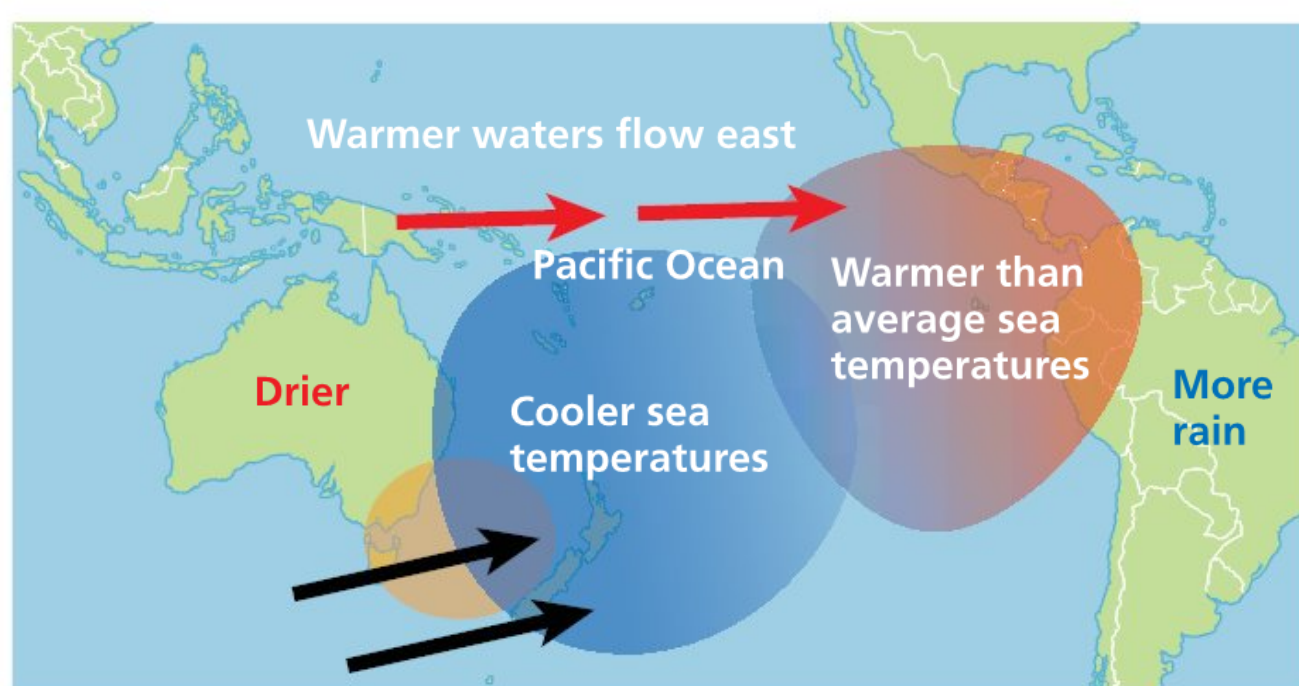


Figure 6.12 The global ocean conveyor belt

Another factor influencing climates and therefore biomes around the globe is the effect of ocean currents. The ocean has areas of warm and cold water. It behaves like a conveyor belt and so is called the ocean conveyor belt. These areas of warm and cold currents can influence climates and, as a result, the local biome. An example of this is the mid-Atlantic drift or the Gulf Stream. This ocean current brings warm water and, in turn, warm, moist air, up to western Europe. Warm, moist air means rain. The latitude of western Europe should mean that this area has a cold climate, but the Gulf Stream's warm, moist air means that it is warmer and wetter, which is then reflected in the biome.

El Niño is a climate cycle that sends warmer ocean currents in the Pacific towards South America and away from Southeast Asia, Australia and New Zealand. The cooler sea temperatures that are a result across this region mean there is less evaporation and so less rainfall. This makes these countries drier than normal, and drought and wildfires can occur. In South America, there is heavier rainfall than usual for the time of year and landslides are common. Fish change their breeding patterns and where they will live, and coastal people who rely on the fish for their income often lose money.



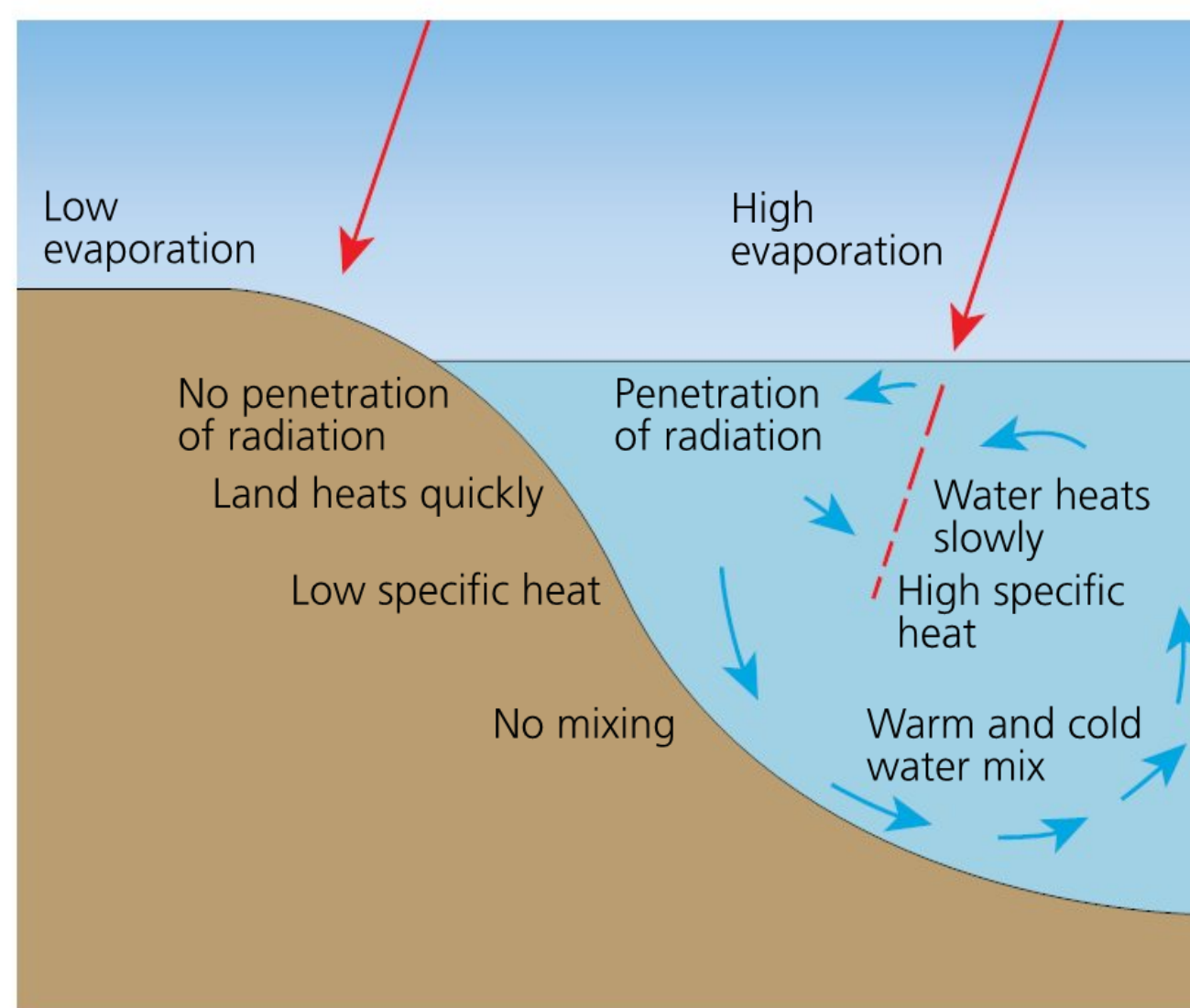
■ **Figure 6.13** Changes in the Pacific Ocean temperature during an El Niño

EXTENSION: EXPLORE FURTHER

Explore further into the El Niño current in the Pacific Ocean and how it can affect the climates around the globe.

DISTANCE FROM THE SEA

Areas near the coast tend to be warmer than inland areas during winter, but during the summer coastal areas tend to be cooler. This is because water takes longer to heat up than land, but retains its heat longer than land. Therefore, inland areas can warm up very quickly, but during the night or winter months, they can be very cold.



■ **Figure 6.14** How water retains its heat

Links to: Sciences

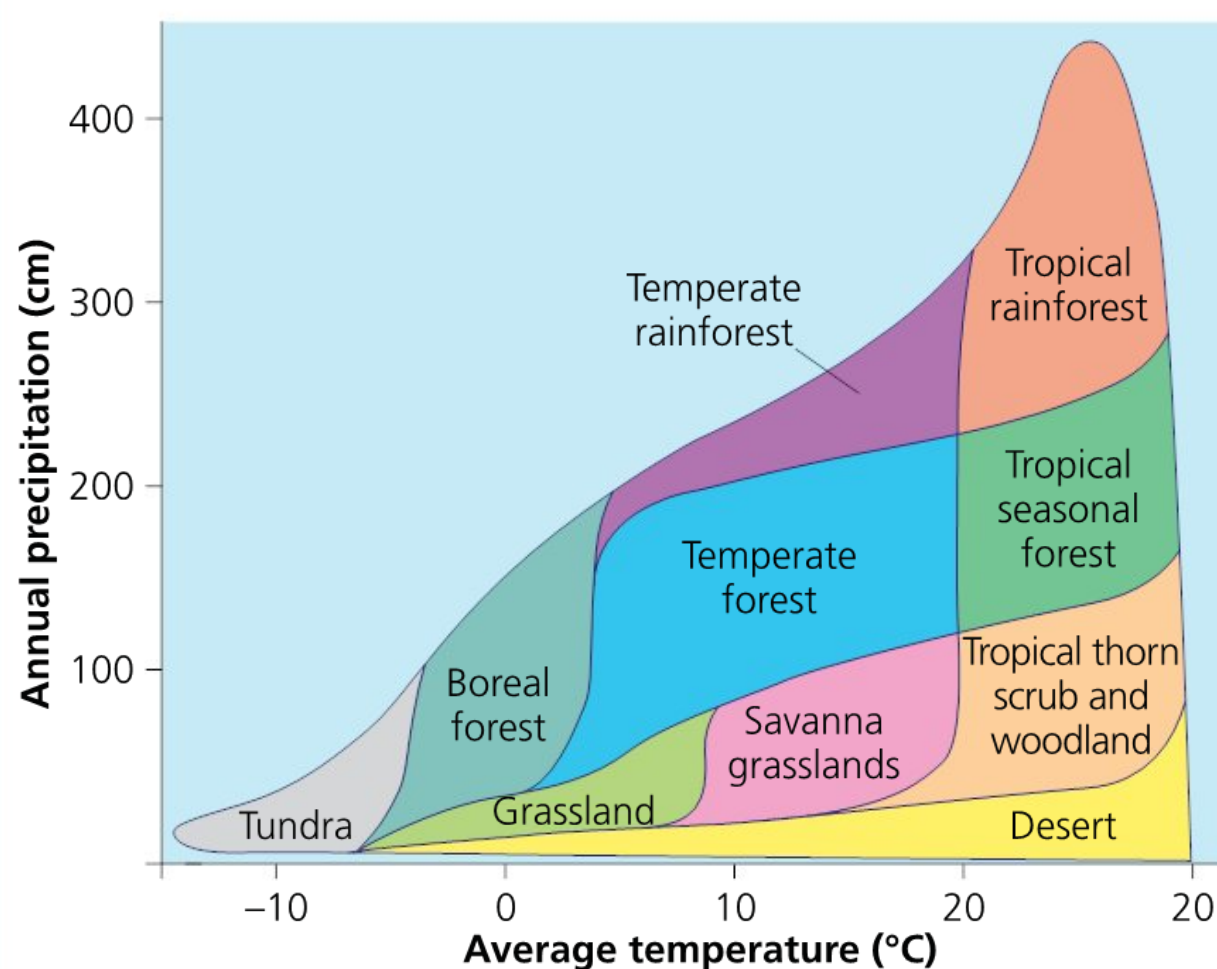
In *MYP Sciences by Concept 3* and *MYP Physics by Concept 4&5* you may have **explored** the variation of atmospheric variables such as temperature and pressure with altitude. You may also have **investigated** the specific heat capacity of different materials (solid, liquid or gas).

ACTIVITY: Revision guide to biome location

■ ATL

- Communication skills: Use appropriate forms of writing for different purposes and audiences

You are going to **create** a revision guide for your peers on how the climate can affect where two or three biomes are located. Figure 6.15 can be used to help decide which biomas you could write about.



■ **Figure 6.15** Summary (known as the Whittaker Biome diagram, 1975) of the main land biomes and the link to their climate

- **Describe where the biomes are.** Provide a map of the locations and a description.
- **Describe the climates.** You could provide climate graphs, but if you do, you must remember to describe them as well.
- **Explain how the biomes are located.** Using the information on the previous pages, link your explanations to latitude, pressure belts, ocean currents, altitude and distance from the sea.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding and Criterion C: Communicating.

ACTIVITY: Using GIS to explore changes in land surface

■ ATL

- Information literacy skills: Make connections between various sources of information

Work in pairs.

View the global seasonal changes map here:

<http://arcg.is/mDOfe>

Click the *Play* button on the time slider at the bottom of the map to see changes in land cover over one year.

- 1 **Identify regions with respectively increasing and decreasing snow cover, vegetation cover and dry land cover.**
- 2 **Describe the pattern of change in land surface cover from January 2004 to January 2005.** Remember to base your description on global geographical features such as continents, oceans and latitudes.
- 3 **Explain the pattern described in Question 2.** **To what extent does it link to the climate zones you have learnt about in this chapter (page 127).** **Justify your points with reference to specific biomes and climates.**
- 4 **Discuss your findings with a partner.**

EXTENSION

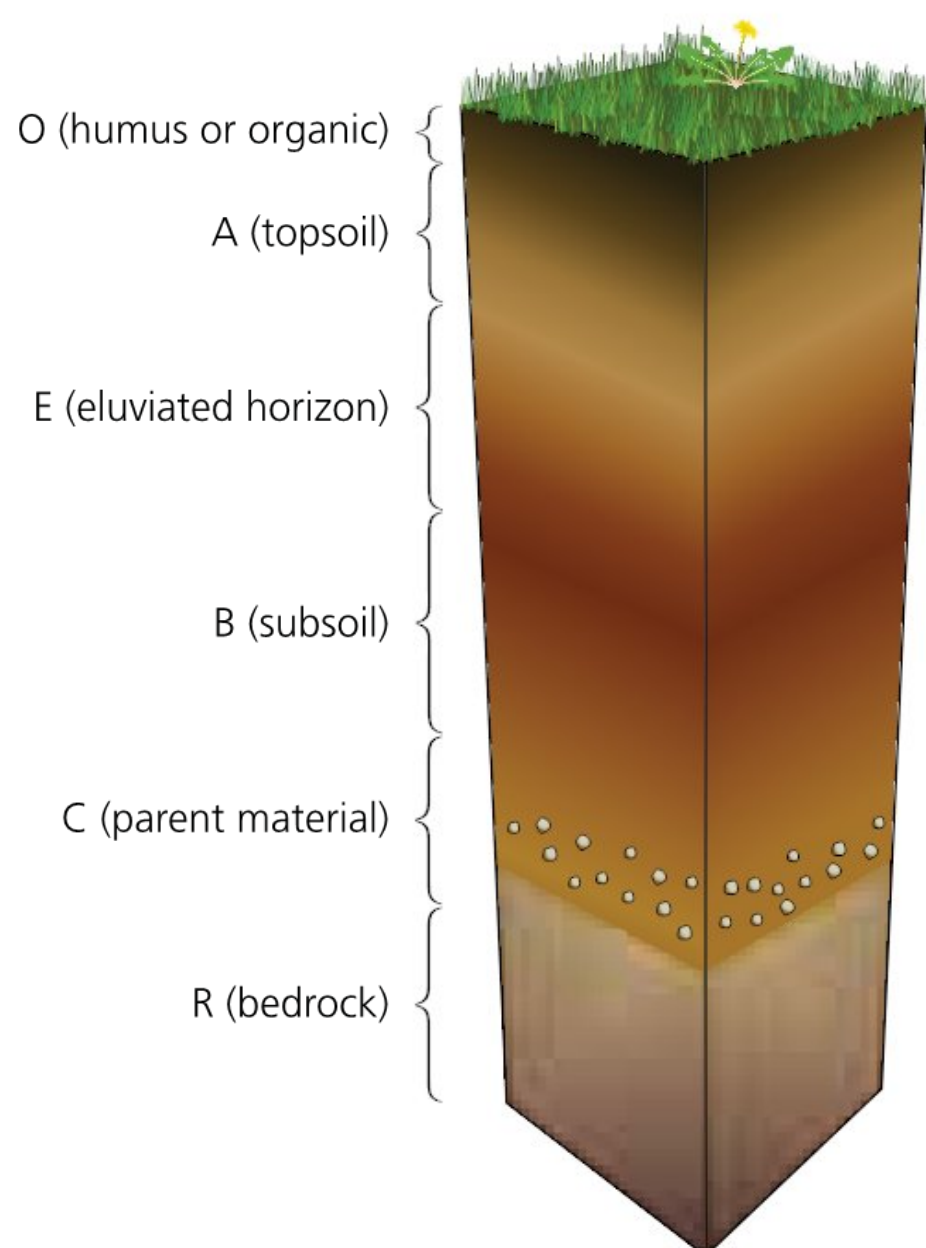
Log into your public ArcGIS Online account and save the map, giving it a suitable title. You could then **annotate** this map with your answers to Questions 1 to 3 using map notes (see page 23). Include climate graphs, climate data and pictures showing typical biomes.

What are the main processes in a biome?

We have seen that biomes are linked to climate, but what happens within the biomes themselves? Here we will focus on the processes that occur in each biome, looking at the importance of soil and how nutrients are passed through the system, and how all this affects the types of plants and animals that live in the biome.

SOIL

Soil is a thin layer of material that covers the land and is formed from rock (known as the parent rock) that has been broken down via the process of weathering. It is made from minerals from the rock, organic matter, water, air and living organisms. It takes between 500 and 1,000 years for 2.5 cm of soil to form, depending on where you are in the world. Tropical climates have the fastest forming soil. Can you think why?



■ **Figure 6.16**
A soil profile

A soil profile (see Figure 6.16) shows the different parts of the soil from the surface to the parent rock. These can be characterized as layers that show the main features of the soil at different depths. Each biome has a particular soil profile, which varies due to local conditions such as bedrock type. The top layer or horizon has two parts: horizon O, which is where you will find the leaf **litter** and other decomposing matter (such as dead animals and faeces), and horizon A, which is the topsoil, where you will find most of the nutrients;

ACTIVITY: Soil and biomes

■ ATL

- Communication skills: Make inferences and draw conclusions

Study the map (Figure 6.2 on page 126 and Figure 6.6 on page 128) and the photos (Figure 6.7 on page 128) of each biome's vegetation type.

Carry out an online search to **investigate** the soils for each vegetation type and their names.

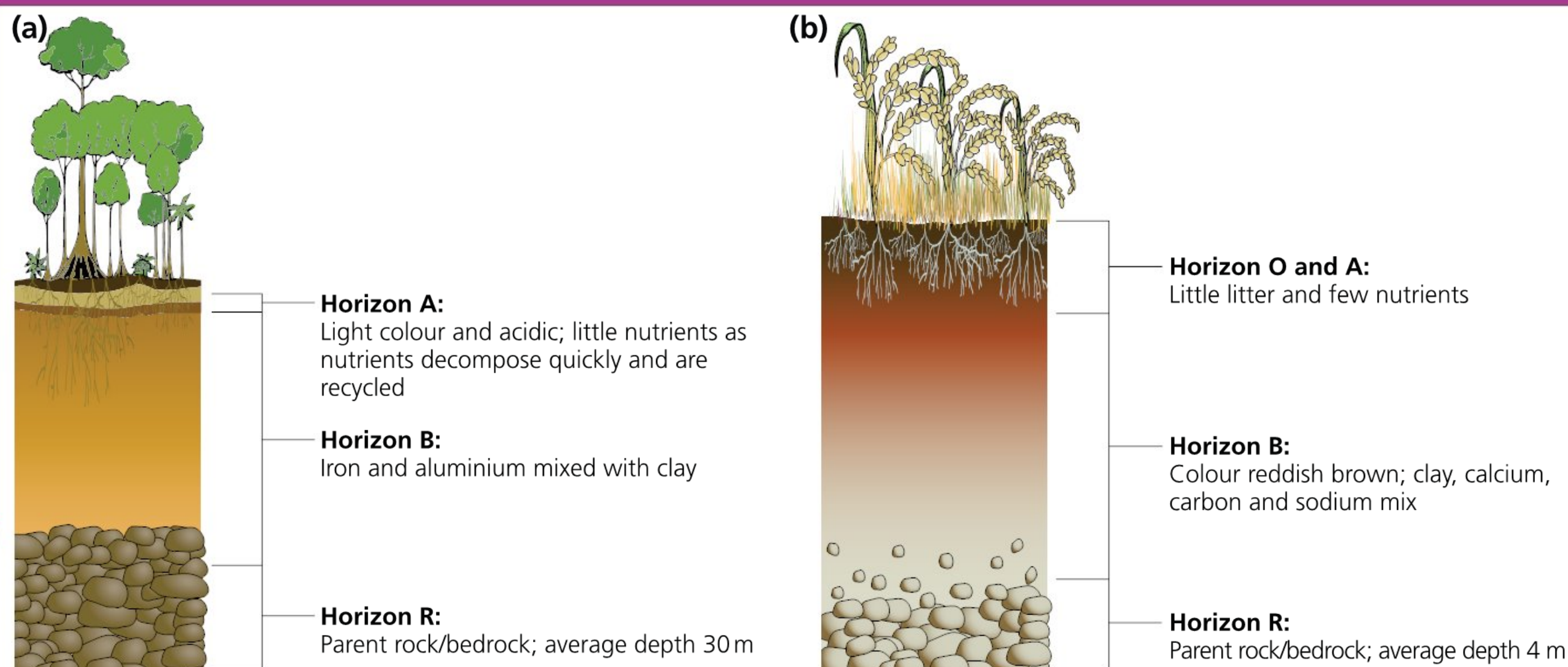
Rank the biomes from 1 for the richest soil type to 8 for the poorest soil type. **Justify** your reasons for the ranking.

this is the most important part of the soil profile. Horizon E is where some of the nutrients start to get leached downwards; this means the nutrients are being taken away, usually by the water percolating through the profile, in a process known as leaching. Horizon B is where they accumulate and below that is where you find parent material (horizon C), which is weathered rock from horizon R, the bedrock.

So, what is the importance of soil when studying biomes? Soil factors such as depth, texture, structure, acidity, nutrient content (organic and mineral), and water and air content are important elements when studying the processes within a biome. Soil gives the plants their food, and the climate and rock type can affect how nutrients are stored and transferred to and from the plants. The soil is known as an abiotic element of a biome; this means it is non-living.

In the activity above, some of you might have identified the soil in the tropical rainforest as having the most nutrients. In fact, in the rainforest, it is only the very top of the soil, horizons O and A, that store nutrients; the rest of the profile has very little nutritional value.

This is due to the climate. In the rainforest, the climate is warm and wet throughout the year. Therefore biotic elements (the **flora** and **fauna**) rot, and the nutrients are broken down quickly by **decomposers** (mushrooms/ bacteria). For example, when plants and animals die, they start to decompose very quickly, and the nutrients inside them rot into the soil. The nutrients are taken up by only a small amount of plants just as quickly and so nutrients infiltrate into the profiles. Leaching of nutrients occurs quickly due to the rain levels and lack of vegetation. Therefore, the only section with a significant amount of nutrient is horizon O and A.



■ **Figure 6.17** Soil profiles: **(a)** tropical rainforest and **(b)** savanna grassland

Look at the differences in depth, structure (where the horizons are) and nutrient content in the two soil profiles in Figure 6.17.

ACTIVITY: Soil profiles and tropical rainforest and savanna grassland biomes

■ ATL

■ Communication skills: Make inferences and draw conclusions

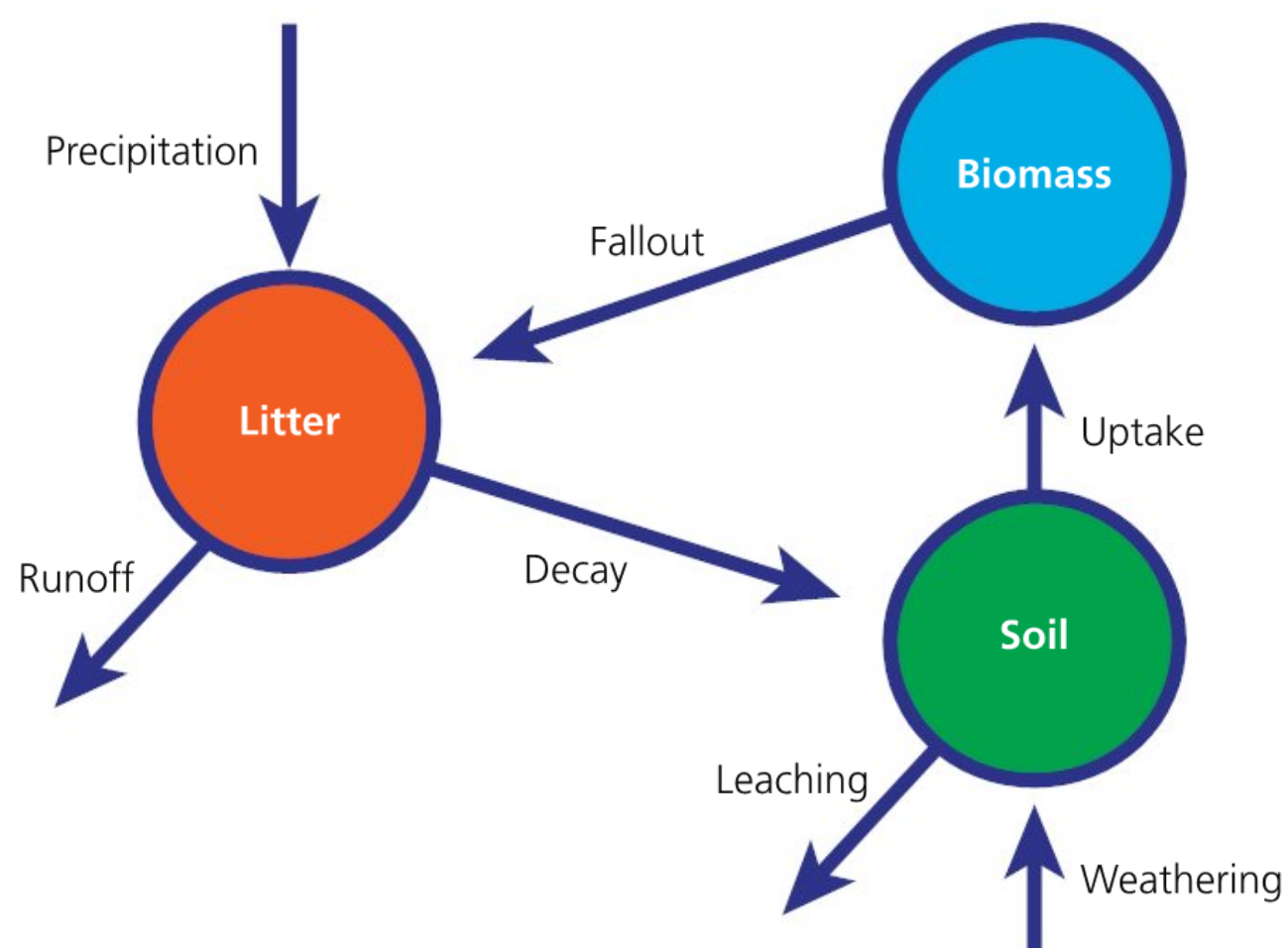
Describe the soil profiles shown in Figure 6.17. Using your knowledge of the climate in each biome, **explain** the process that creates the soil profiles.

◆ Assessment opportunities

◆ This activity can be assessed using Criterion A: Knowing and understanding.

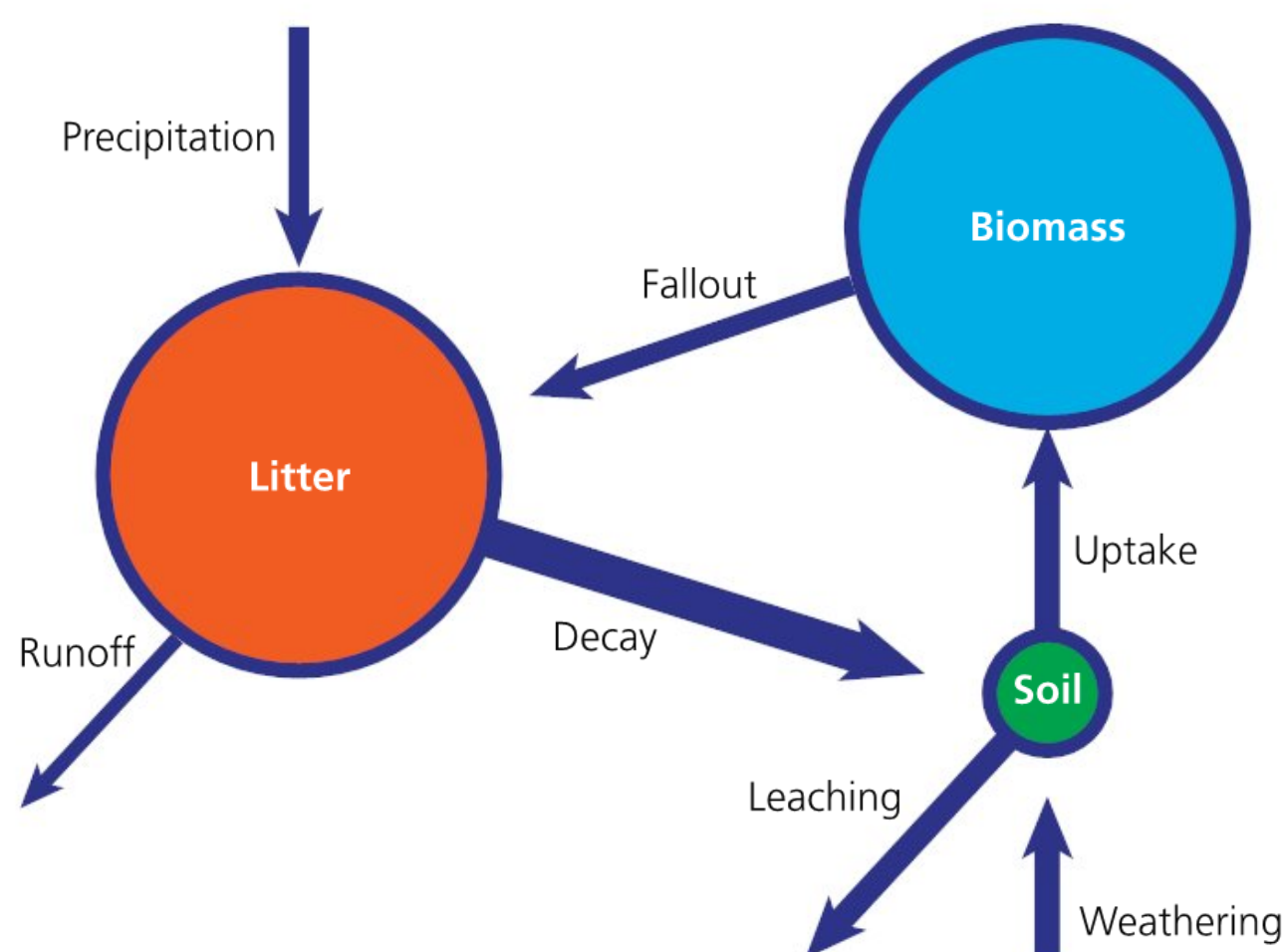
NUTRIENT CYCLES

A biome is a large ecosystem that allows nutrients to be transferred and stored. Nutrients (whether from a dead animal or plant) enter the system and can also leave the system. The pace at which the nutrients move around the system depends on the biome. We use **nutrient cycle** diagrams, first developed in 1976 by P.F. Gersmehl, to help us understand the number of nutrients that are inputted, stored, transferred and taken out of each biome. This is, of course, a simplified diagram; the reality of the system and process is much more complex. A nutrient cycle looks at three parts of a biome: biomass, litter and soil. The biomass is the total mass of living organisms per unit area; litter is the organic matter on the surface of the soil, including the humus, which is in horizon O.

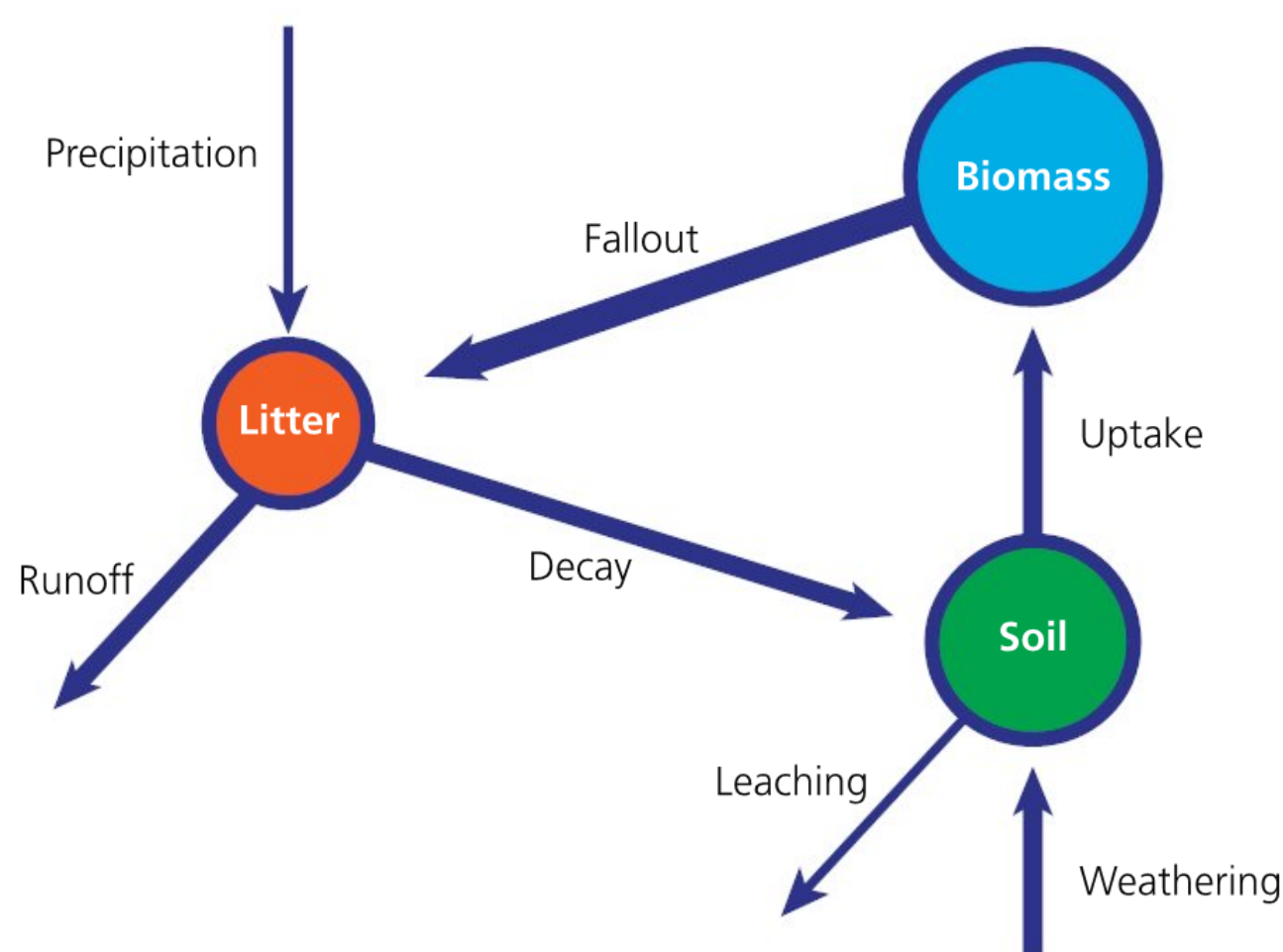


■ **Figure 6.18** Nutrient cycle

Figure 6.18 is a general diagram of the nutrient cycle. Each circle represents the stores in the system; in this example, each store part has the same amount of nutrients stored (in other examples, the larger the circle, the more nutrients are stored and the smaller the circle, the fewer nutrients are stored in that particular area). The arrows show where nutrients are transferred between the stores or the inputs and outputs from the system. (A thicker arrow indicates more nutrients being transferred.)



■ **Figure 6.19** Tropical rainforest nutrient cycle



■ **Figure 6.20** Savanna grassland nutrient cycle

EXPLANATION GAME

I notice that ... (**Describe** the two nutrient cycles in Figures 6.19 and 6.20.)

Why are they that way? Why are the circles (the stores) and the arrows (the transfers) these sizes?

Think back to the maps and photos on pages 126 and 128 to help you.

This can be done individually, in pairs, as a group or even as a whole class.

ACTIVITY: Bringing it all together

■ ATL

■ Communication skills: Structure information in summaries, essays and reports

Investigate another biome type that is not the tropical rainforest or savanna grassland (for example, tundra or desert).

Describe and **explain** the climate (including a climate graph).

Draw and **describe** a soil profile for the biome.

Draw a nutrient cycle for the biome and either **annotate** the diagram or, below the diagram, **explain** the sizes of the stores and flows/transfers.

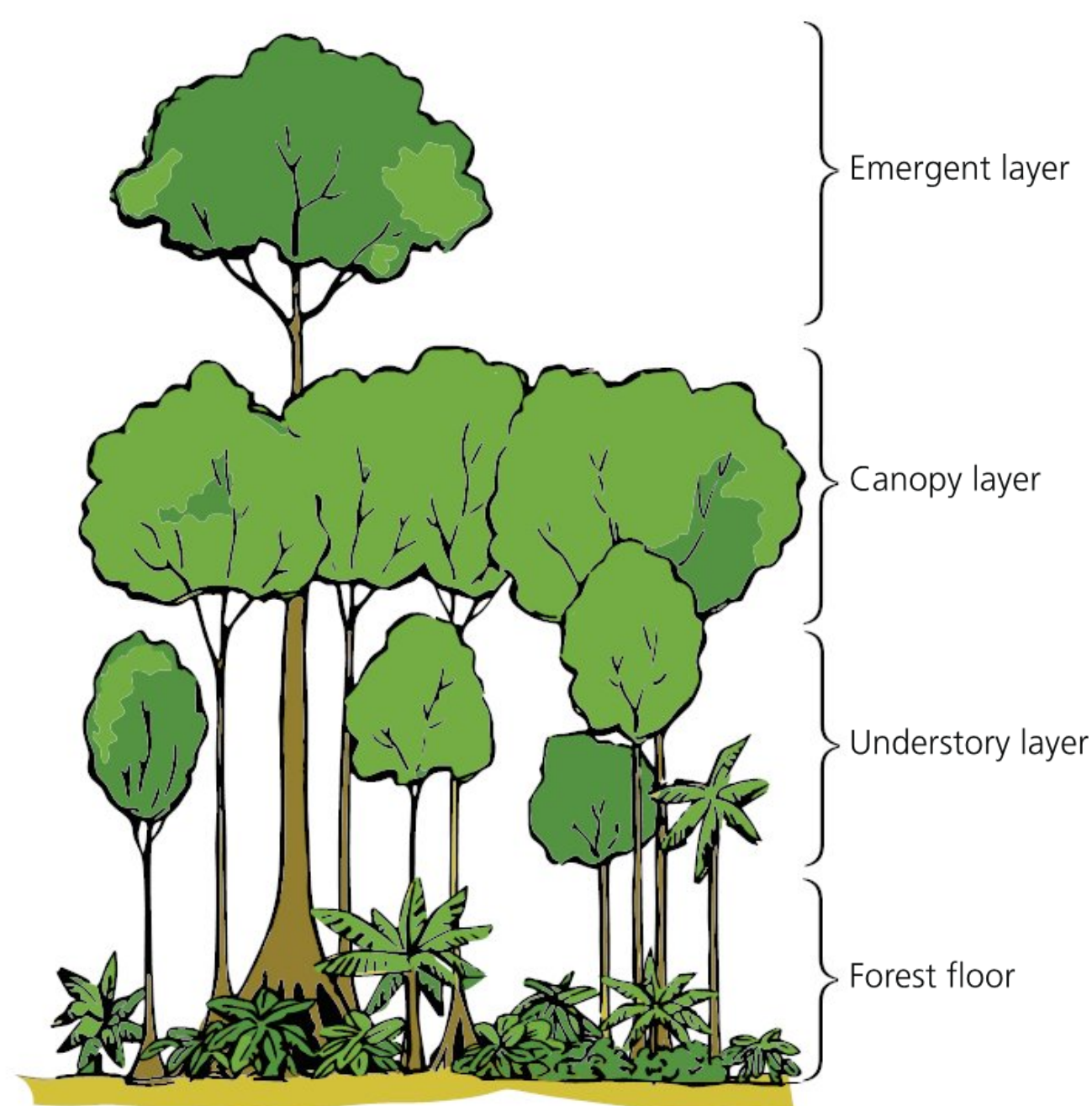
◆ Assessment opportunities

◆ This activity can be assessed using Criterion A: Knowing and understanding and Criterion B: Investigating.

How have plants and animals adapted to their biomes?

Biomes have developed for various reasons, mainly due to climatic processes. The plants and animals, flora and fauna, have also adapted due to the climatic processes and work within the ecosystem. We shall now investigate how plants and animals adapt and compete for the light for photosynthesis, nutrients and water within two biomes: the tropical rainforest and savanna grasslands.

Tropical rainforest



■ **Figure 6.21** Layers of the rainforest

You have seen how the amount of rain, sunlight and soil are essential to the development of biomes. In the tropical rainforest, the climate is hot and humid, so plants can grow extremely quickly, as there are no seasons, just high temperatures and rainfall every day, of every month. Rainforest plants have adapted in various layers (see Figure 6.21) in response to these conditions.

The ground or forest floor receives very little sunlight, while the canopy layer sees considerably more, making it the primary layer for plant and animal life. Plants compete for the sunlight, as they grow fast and produce many leaves. Therefore, over time, plants have adapted to this competition. Some have adapted by growing very fast and just producing leaves at the top of the tree; these are known as the emergent trees. Few leaves grow on the trunk, as this would waste energy that is needed to grow. Some plants have adapted to dark areas, and are therefore found at the understory layer, just above the forest floor. Other plants, such as the lianas, have adapted to get to the sunlight by climbing up other trees. With the heavy rainfall all year round, some plants have what is known as drip tip leaves, which help the rain to run off so the leaves don't become so heavy that they break off from the plant. The large trees in the rainforest have buttress roots. These are able to take up nutrients from the topmost soil and litter, horizon O, as this is where most of the nutrients are in the soil. This is a very rapid process, so very few nutrients are stored in the soil. As the roots of the tree are very shallow, they do not provide an anchor to keep the tree from falling down, and therefore the shape of the roots helps to give the trees a solid base.

ACTIVITY

Find out what **epiphytes** are. **Explain** how have they adapted to the tropical rainforest environment.

THINK–PAIR–SHARE

Look at the photo of the savanna grasslands (Figure 6.22). **Describe** the plants you see. Look back to the savanna grassland climate graph (Figure 6.5, page 127). How do you think the plants have adapted to the climate? Share your ideas with the rest of the class.

Savanna grasslands



■ **Figure 6.22** Vegetation in the savanna grasslands

ACTIVITY: How plants adapt to the tropical rainforest and savanna grasslands

■ ATL

- Information literacy skills: Access information to be informed and inform others

Research how plant life has adapted in the tropical rainforest and the savanna grasslands.

- **Draw/sketch** two or three different plants that can be found in each biome.
- **Annotate** each plant to **show** how the main features of it have adapted to the climate. For example, focus on leaves, root length, store of water or growing season.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding and Criterion C: Communicating.



Annotations

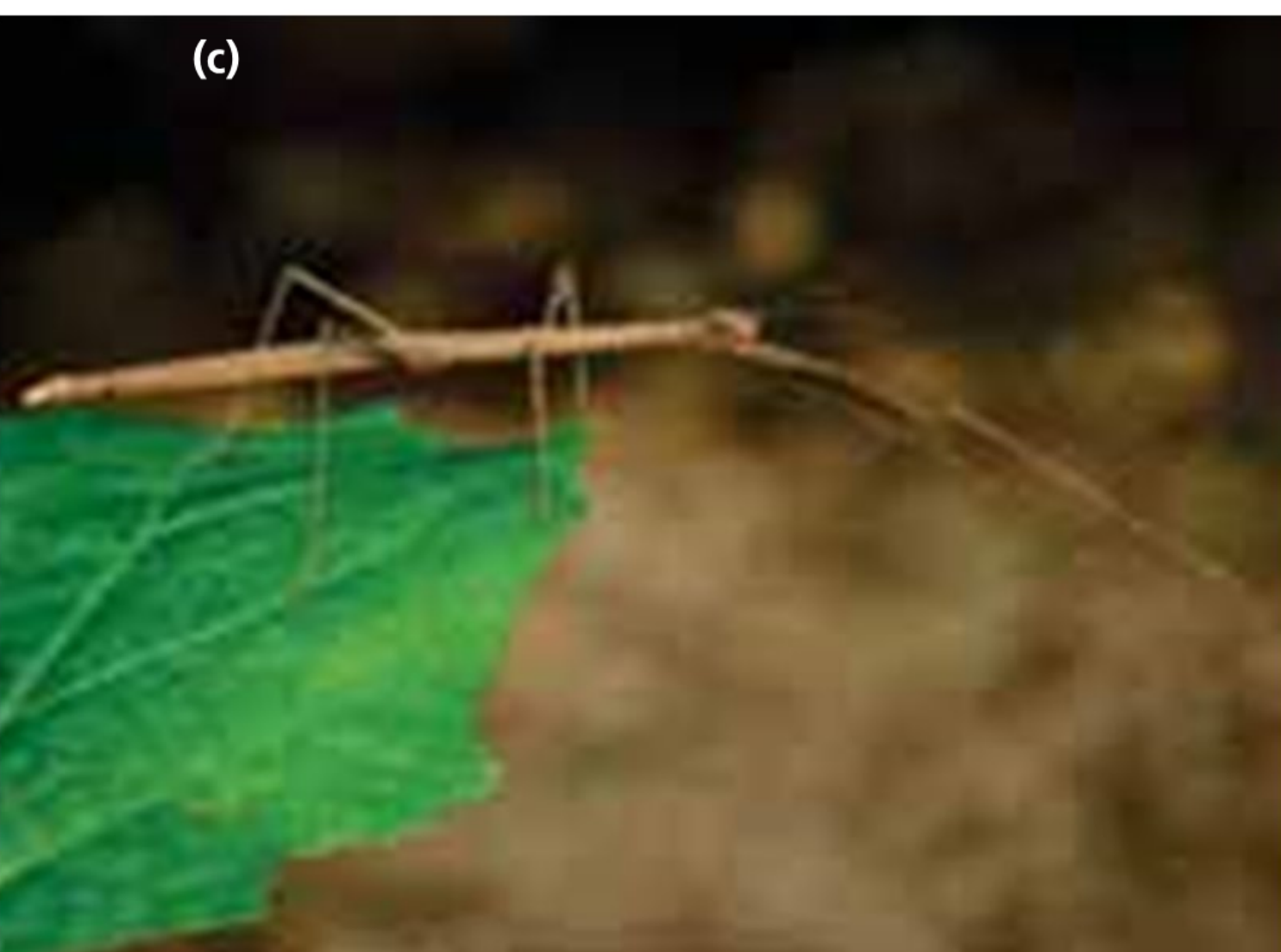
Annotations do not just describe a graph, map or diagram. They are also a way of explaining how or why things are the way they are. For example, in this activity, you have been asked to **annotate** how a plant has adapted to its climate. You could start by **describing** the feature of the plant and then say why the feature is like that. The annotation should be a summary and not a lengthy explanation. Each annotation should have an arrow pointing directly to the part of the image that you are **explaining**.

▼ Links to: Sciences, Biology

How is energy transferred from one living organism to another?

This topic is discussed in *MYP Sciences by Concept 4&5* pages 135 and 294–96 and *MYP Individuals & Societies by Concept 2*, pages 38–41.

FOOD CHAINS, TROPHIC LEVELS AND FOOD WEBS



■ **Figure 6.23** Living organisms in the tropical rainforest: **(a)** wild yellow squirrel monkey, **(b)** jaguar, **(c)** stick insect, **(d)** rainforest mushroom

ACTIVITY: A food chain in the tropical rainforest

■ ATL

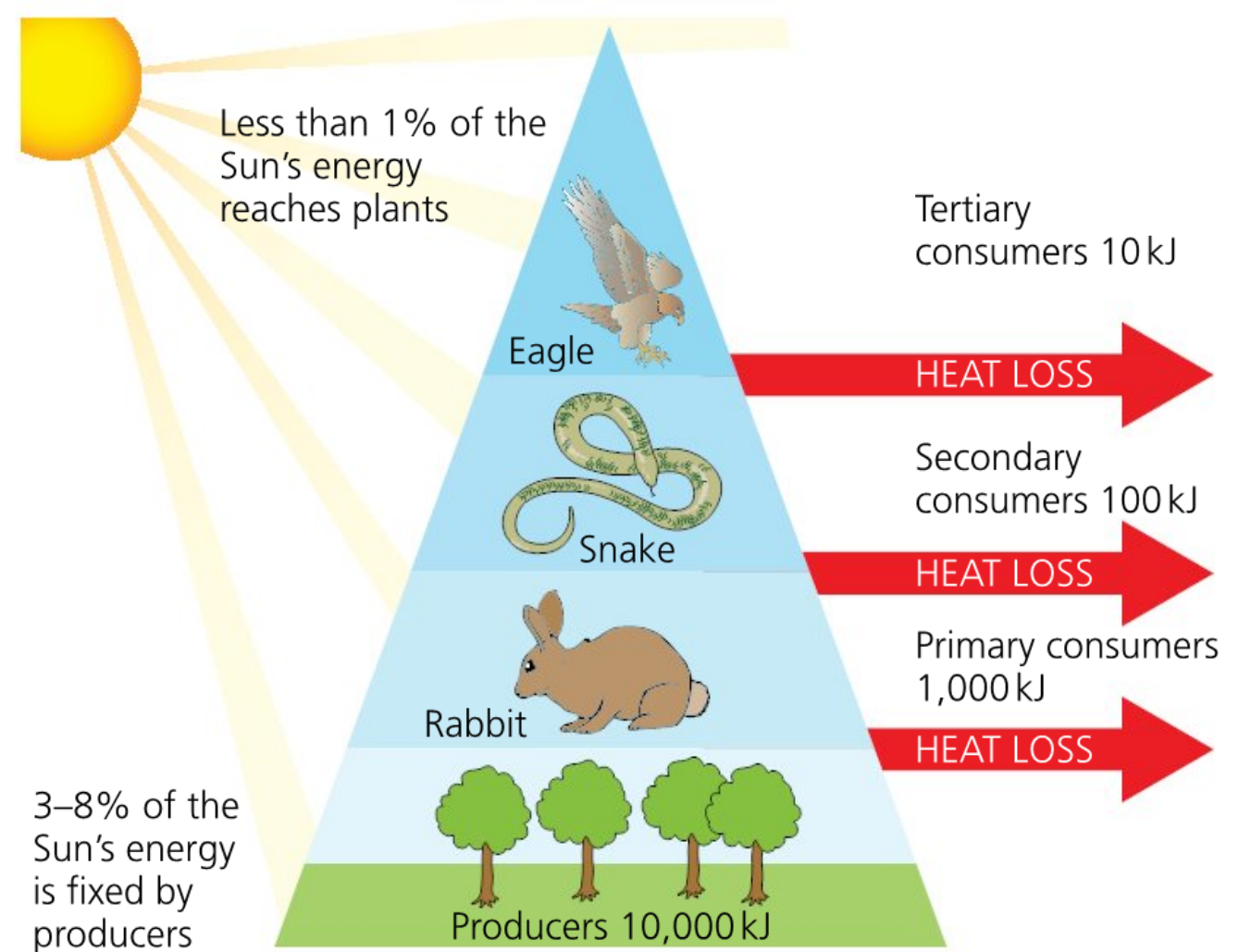
- Communication skills: Organize and depict information logically

Create a rainforest **food chain** using the key words listed below, and the living organisms in Figure 6.23.

producers, consumers (primary, secondary and **tertiary**), decomposer

Share your ideas with the rest of the class. Do you all agree as to the correct positions of the organisms within the food chain?

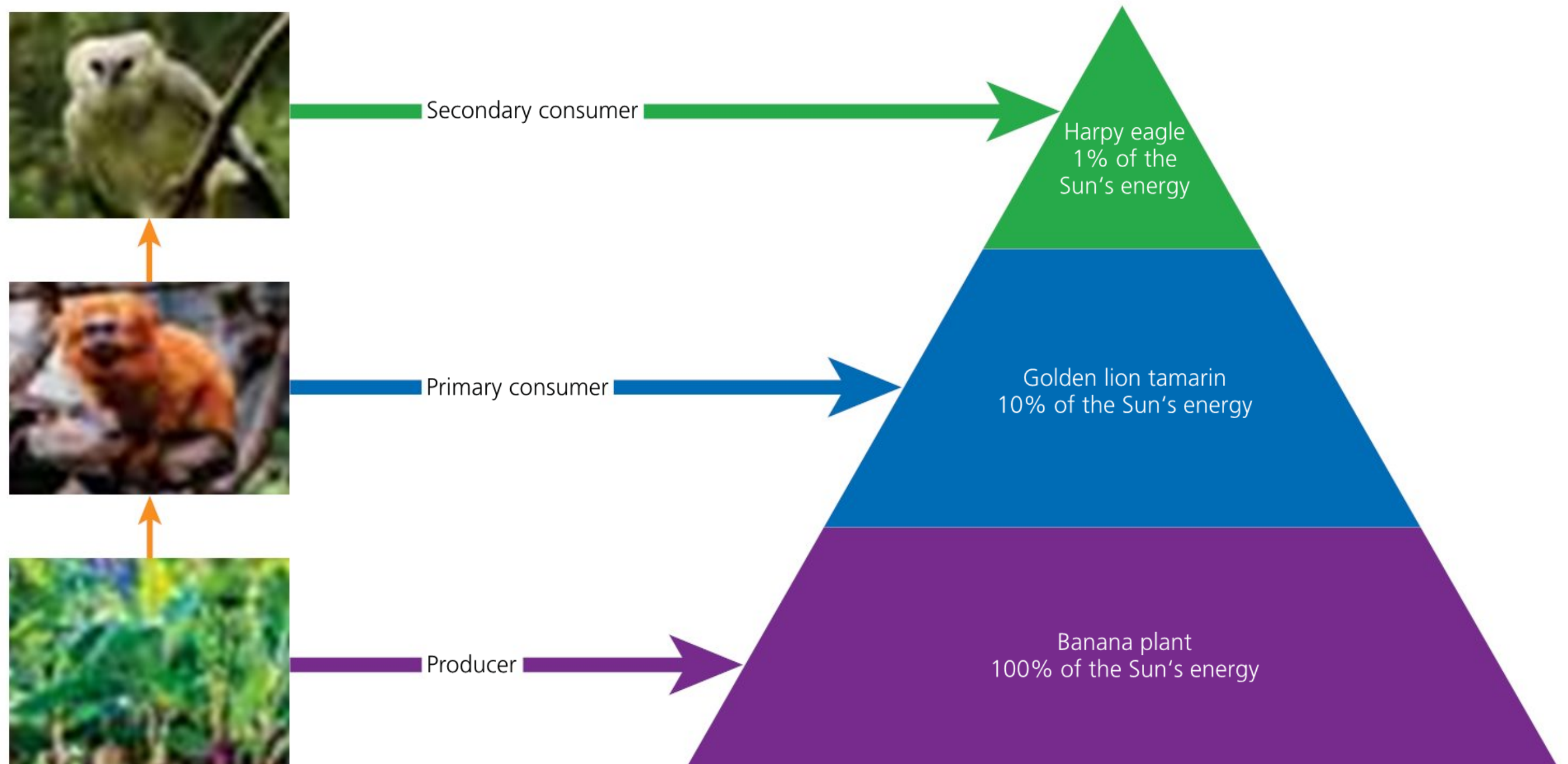
The **trophic level** is a visual representation of how the energy of a food chain changes as you go up each level, from the **producers** to the top/**apex** predator. Figure 6.24 shows a general trophic level diagram. It represents how much energy is taken by each stage of the food chain. It starts from level 1 with the primary producers and moves to level 2, **herbivores** (**primary consumer**) and to level 3, predators (**secondary consumer**), and then ends at level 4 or 5 at the apex predator. The reality is that ecosystem communities have complex paths through the trophic levels, interlinking into many **food webs**.



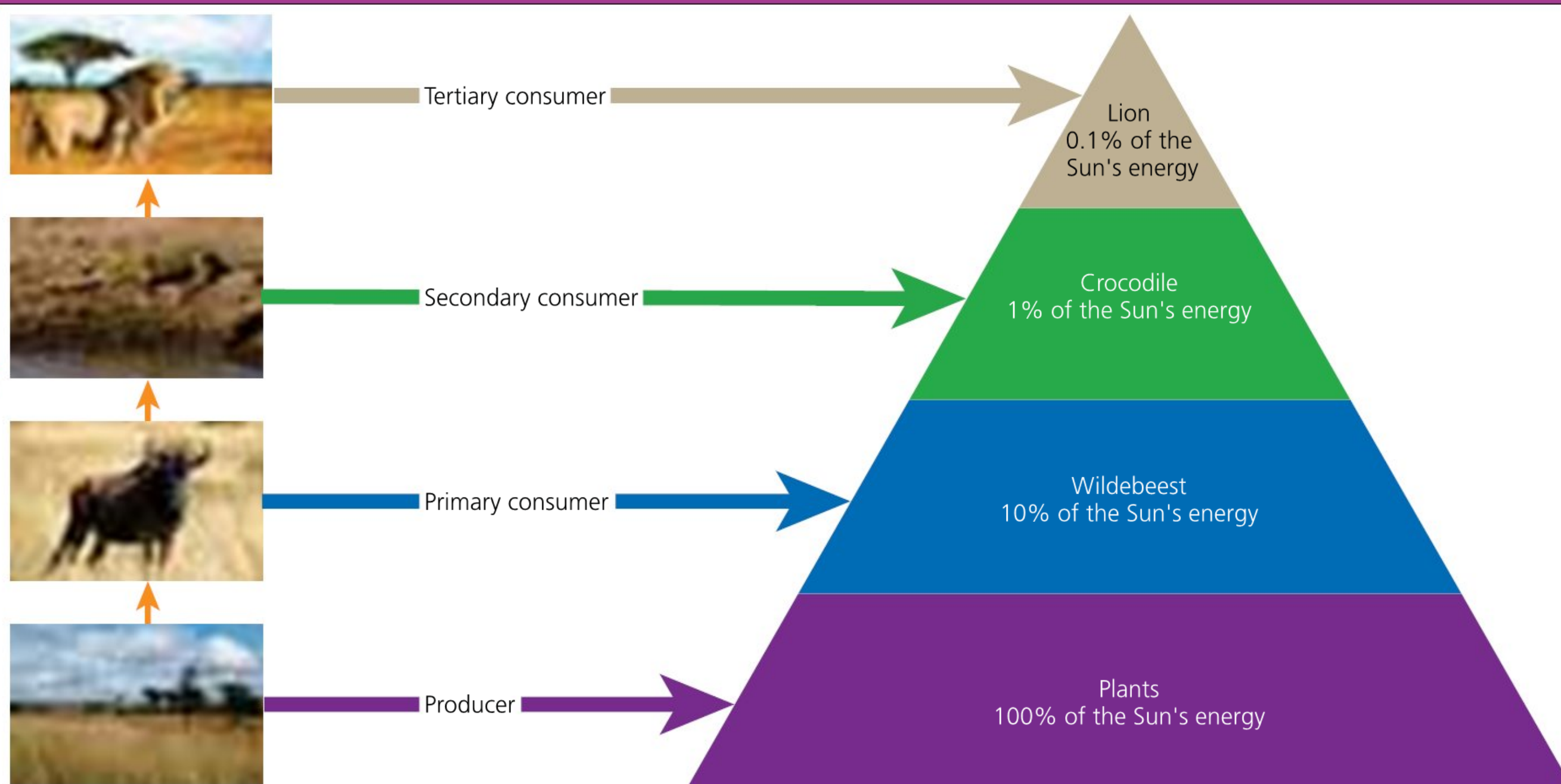
■ **Figure 6.24** Trophic levels

DISCUSS

Looking at Figure 6.24, **discuss** how energy transfers from one species to another. **Suggest** why the amount of energy decreases as you go up the trophic levels.



■ **Figure 6.25** Trophic levels in the tropical rainforest



■ **Figure 6.26** Trophic levels in the savanna grasslands

DISCUSS

Discuss how the two trophic levels for each biome (see Figures 6.25 and 6.26 are similar to and different from each other. Give reasons for differences and similarities.

Food webs are more complex versions of food chains. Many primary consumers eat the same producers and many secondary consumers eat the same primary consumers; therefore, instead of a simple chain, the living organisms are interlinked in a web.

ACTIVITY: Food webs

■ ATL

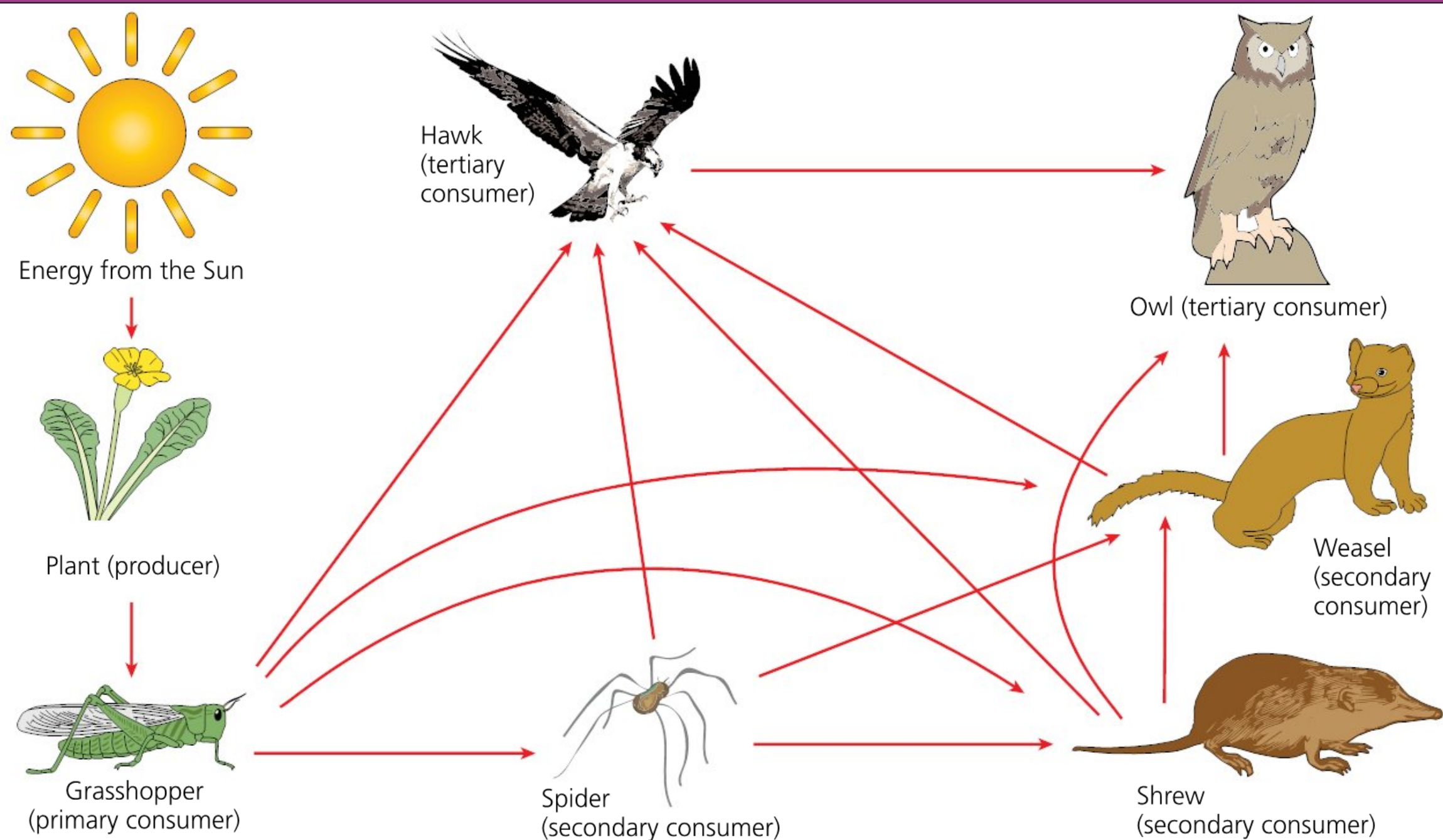
- Communication skills: Take effective notes in class
- Information literacy skills: Access information to be informed and to inform others

For the tropical rainforest and savanna grasslands (or other biomes that you have been researching yourself), carry out some research and then **create** a food web to represent the relationships within each biome. Then answer the following questions:

- What would happen if the producer numbers were reduced?
- What would happen if the numbers of one of the primary consumers increased? How could that happen in your chosen biome?
- What would be the impact if the numbers of one of the secondary consumers decreased?
- How could humans play a role in the food web?

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding and Criterion D: Thinking critically.



■ **Figure 6.27** An example of a food web in a woodland

HOW DO ANIMALS ADAPT IN THEIR BIOME?

Animals have to compete with each other for food, water and a place to live; they also have to adapt to the climate and the vegetation in their environment. For example, a giraffe is well adapted to live in the savanna grasslands due to its long neck and tall body which enable it to eat the more nutritious leaves at the top of trees during drought times (the dry season). Can you think of other ways in which the giraffe's body has adapted to the savanna grassland? Similarly, in the tropical rainforest, the poison dart frog is brightly coloured to warn off predators, and its feet have pads to help it climb up trees.

ACTIVITY: How do animals adapt to the tropical rainforest?

■ ATL

- Information literacy skills: Access information to be informed and inform others

Plants and animals interact with each other and are part of an ecosystem; in this case, the tropical rainforest. As the plants have adapted to the climate, the animals have adapted to the vegetation. In this activity, you will be researching how animals have adapted to the tropical rainforest biome.

Investigate further into the living organisms of the rainforest shown in the photos in Figure 6.23.

Describe and **explain** how each of them has adapted to the tropical rainforest.

Hint

Think in terms of their physical bodies, when they are awake (nocturnal/diurnal), what they eat, where they live, the type of climate they need.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding and Criterion B: Investigating.

ACTIVITY: Fieldwork – comparing two contrasting ecosystems

■ ATL

- Communication skills: Structure information in summaries, essays and reports
- Information literacy skills: Collect, record and verify data; Process data and report results

This is just one example of the type of fieldwork you could conduct when studying biomes.

First answer these questions:

- What is your research question? What abiotic factors influence plant life at two contrasting ecosystems?
- Where are you going to conduct your research?
- Methodology: How are you going to collect your primary data?

Next you must **select** at least two different ecosystems that are safe to study.

To study abiotic factors, you could look at the microclimate and the soil. Choose one place in the sample area to collect this information.

Microclimate

Air, ground and soil temperature

- Air: Have a thermometer on a pole at about 1 m 50 cm. Leave, but make sure it is out of the Sun. Take the temperature every 15 minutes while you are conducting the fieldwork.
- Ground: Have a ground thermometer to measure the temperature at the ground. Again, take the temperature every 15 minutes.
- Soil: Have a soil thermometer and put it in the soil at about 5 cm. Again, take the temperature every 15 minutes.



■ **Figure 6.28** Using a whirling hygrometer

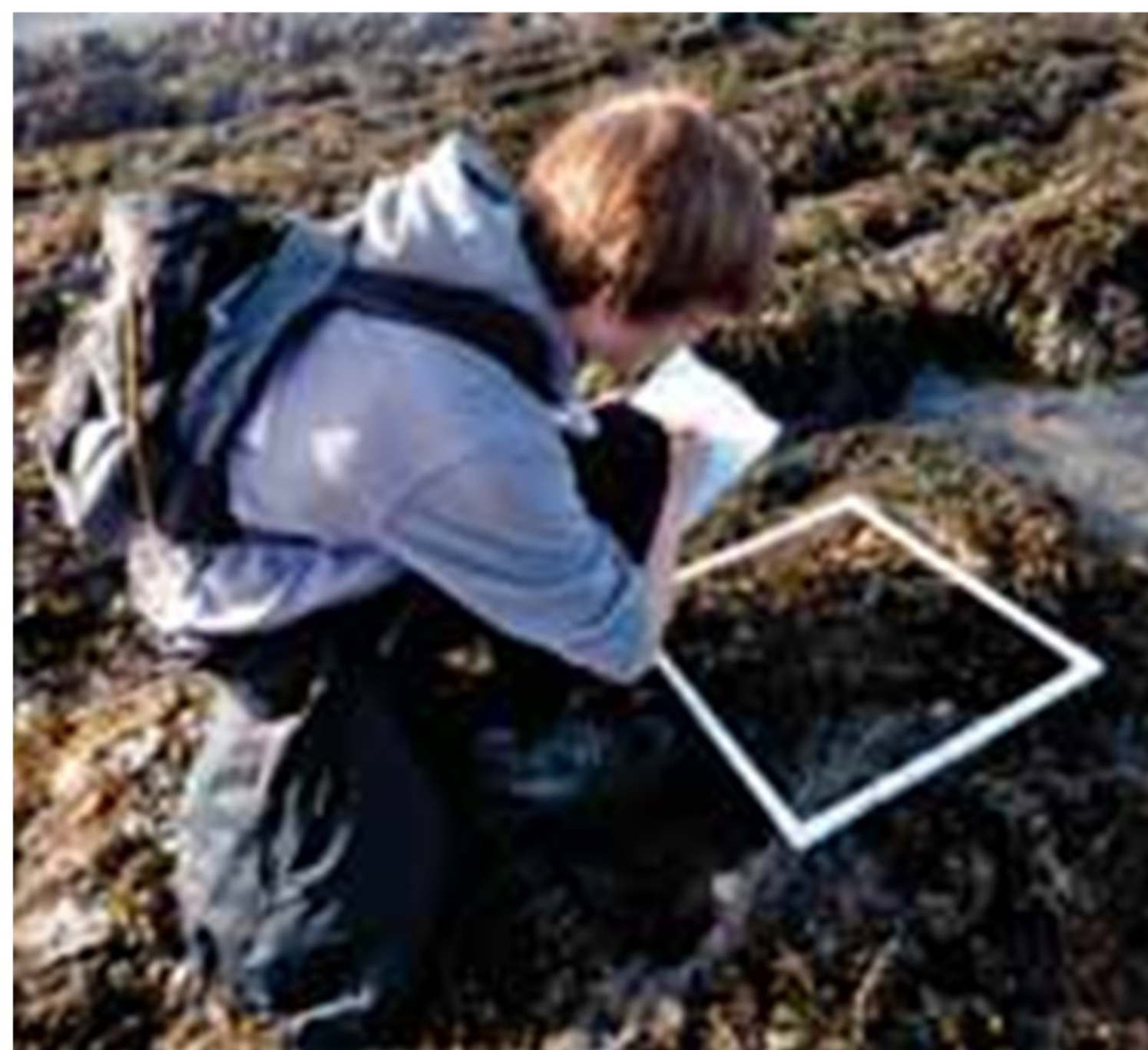
Ground and air humidity

- Ground: Use a ground **hygrometer** to measure the humidity, making sure that the holes at the back are not covered.
- Air: Whirl a whirling hygrometer for about one minute, record the number and then use the converting chart to **calculate** the percentage humidity. (Digital hygrometers can record the humidity straight away.)

Soil

Soil depth and pH

- Dig to horizon B and **measure** its depth from horizon O to the top of horizon C. Take a sample from the A horizon and can a sample of the pH (by a digital probe). Using the rest of the soil sample from horizons O, A and B damping smear some on a piece of paper to see the colour of each horizon.



■ **Figure 6.29** Using a quadrat

To study the biotic factors, you could look at the plants using a **quadrat**, and a transect/belt systematic sampling technique.

- Every 5 m or so, place the quadrat down and on a recording sheet mark the percentage of plants that you find at each site. You should have a plant identity chart or access to the internet, or there are many apps for plant identification. The belt-transect will be approximately 30 m or so.

Data

How are you going to show your data and how do the data link to your fieldwork aim?

You must **analyse** what the data show. **Describe** the data in detail and how they show the changes (or don't show the changes). Of plants, you must bring the abiotic and biotic (plant species) together. Is there a relationship between soil, microclimate factors and plant life in the different ecosystems? You might find that there are some data that do not fit with the pattern you have found. This is known as an anomaly, and it is essential to mention this and try to give reasons why it has occurred.

What do you conclude? Can you say that there is a link/relationship between abiotic and biotic factors in the two ecosystems?

Evaluation of the fieldwork

How can you improve your study? How can you **develop** your studies further? It is essential to **evaluate** your methods and how you could improve them. How could you carry out more in-depth research or further study?

◆ Assessment opportunities

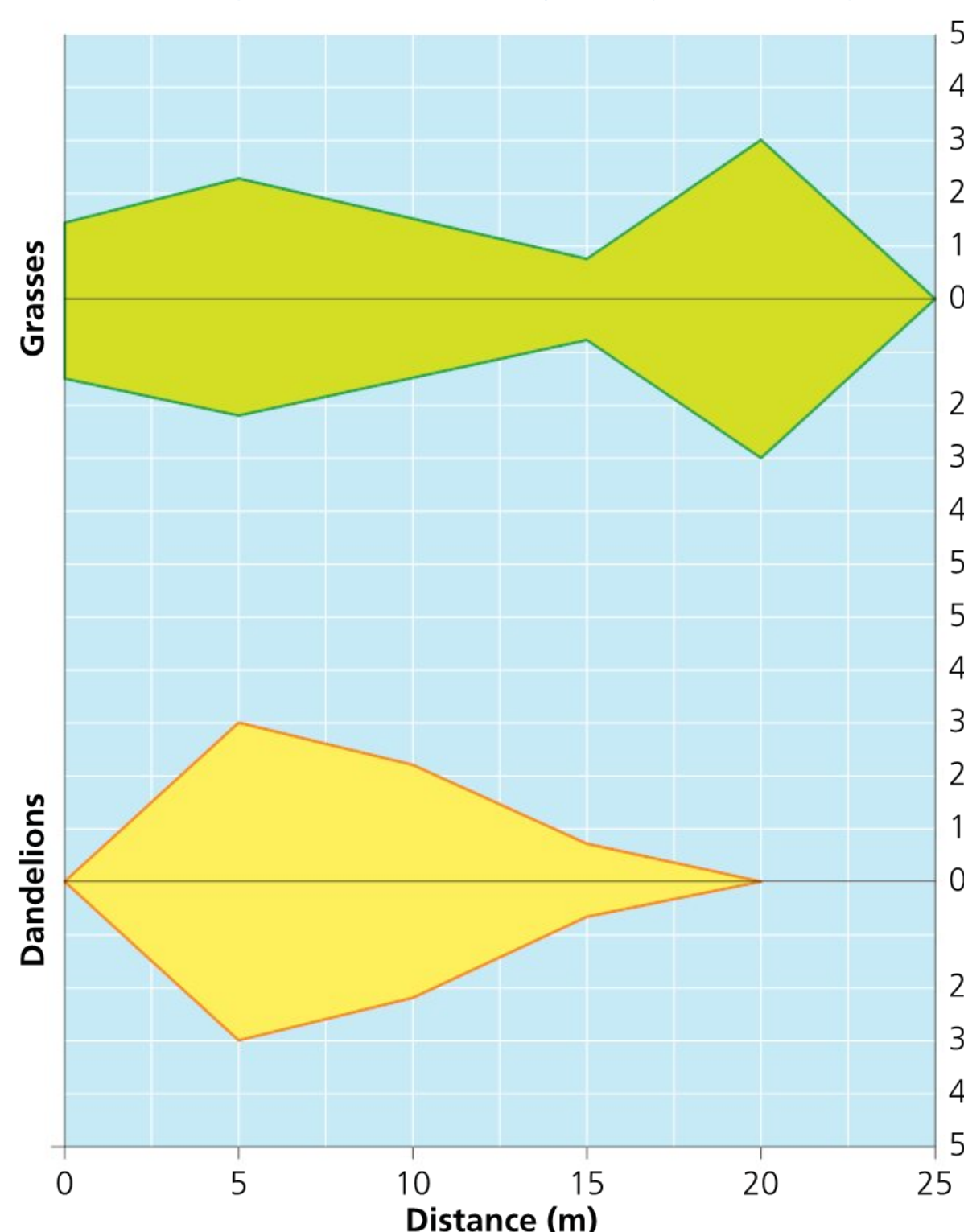
- ◆ This activity can be assessed using Criterion A: Knowing and understanding, Criterion B: Investigating, Criterion C: Communicating and Criterion D: Thinking critically.



How to represent data

Data representation must be easy to read.

One method for showing the abundance of plant species along the transect is by using a kite diagram.



■ **Figure 6.30** Kite diagrams

It is usual to plot the number of plants above and below the line for that plant type (for example, dandelion).

The amounts are plotted half above the line and half below the line. In Figure 6.30, for example, at 5 metres there are six dandelions in the quadrat.

Once the transect is completed, the points are linked together.

DISCUSS

What other abiotic and biotic factors could you conduct a fieldwork on? How could you do this?

How have indigenous people adapted to their biomes?

For centuries biomes have been managed by humans. Some regions still have people managing the land as their ancestors did before them. These indigenous peoples have inherited the cultures and ways of relating to the environment of their ancestors.



■ **Figure 6.31** A member of a tropical rainforest tribe

DISCUSS

Look at the photos of indigenous people from the tropical rainforest and the savanna grasslands. How do you think their traditional way of life has adapted to the biome they live in. What evidence from the photos tell you about how they have adapted to their environment?



■ **Figure 6.32** Maasai people – a savanna grassland tribe

The traditional way of life for many people in the rainforest has been to live in small tribes, hunting for and gathering their food. For example, many different tribes live and work in the Amazon rainforest. Some tribes are hunters and gatherers: hunting for meat and collecting fruit and nuts. Some tribes have learnt to climb the larger trees to collect animals that they have killed from the canopy and foodstuffs, such as nuts and honey. They live in small huts made from plants from the forest. Some stay in one place for only a short time. They burn part of the forest to clear it and grow food, and then, once the soil has been exhausted, they move to another part of the forest and continue the same process. This is part of their culture.

In *MYP Individuals & Societies by Concept 3*, Chapter 5 looks at the topic of what culture is. Anthropologists look to understand human societies by exploring social structures, and how these can be expressed in group identity.

DISCUSS

How much does the physical environment affect people’s cultures? Can we see any similarities between different indigenous groups that live in the same biome?

ACTIVITY: How indigenous groups manage the land

■ ATL

■ Critical-thinking skills: Gather and organize relevant information to formulate an argument

Focus on two or three indigenous tribes from the tropical rainforest or the savanna grasslands. Research aspects of their culture as listed in Table 6.3. Copy and complete the table to help you with your notes.

Name of biome:	Names of indigenous tribes:	
Cultural trait	Similarities	Differences
Food		
Housing		
Family unit		
Clothing		
Farming/ collection of food		
Myths and beliefs		

■ **Table 6.3** Cultural traits of indigenous tribes

- 1 How has each group of people adapted to their environment?
- 2 To what extent do indigenous people living in tropical rainforests or savanna grasslands have the same cultural traits as each other?

Use websites such as: www.rainforestinfo.org.au/background/people.htm, which looks at indigenous people such as the Penan of Sarawak, the Yanomami of Brazil, the Kuku-Yalanji of North East Queensland, Australia, the Pygmies of Central Africa and the Desana of Colombia and at indigenous people and rainforest protection.

Annotate a map with the information you have found from the website.

[Link to *Individuals & Societies 3*: Chapter 5 What is culture?]

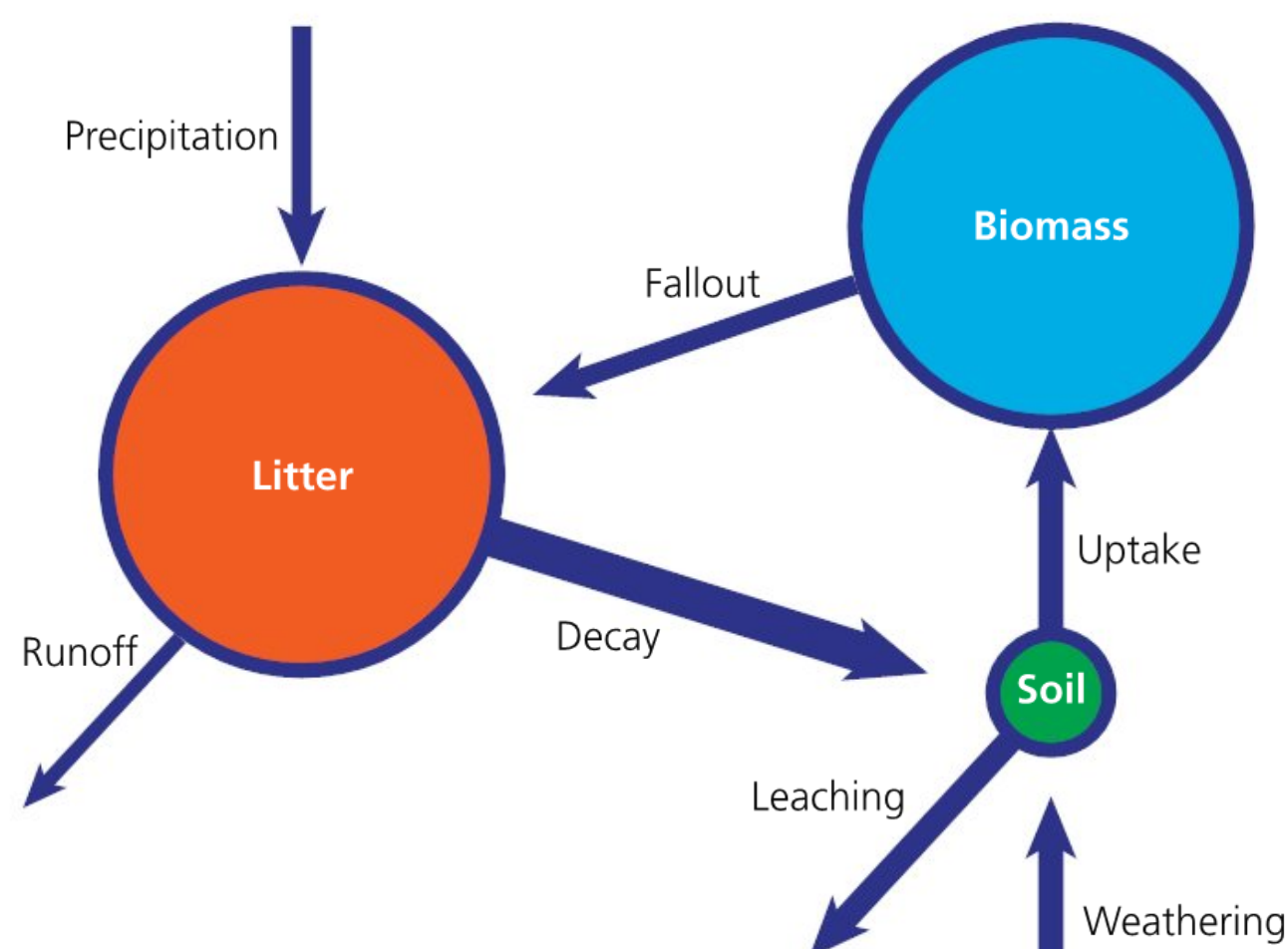
◆ Assessment opportunities

◆ In this activity you have practised skills that are assessed using Criterion B: Investigating and Criterion D: Thinking critically.

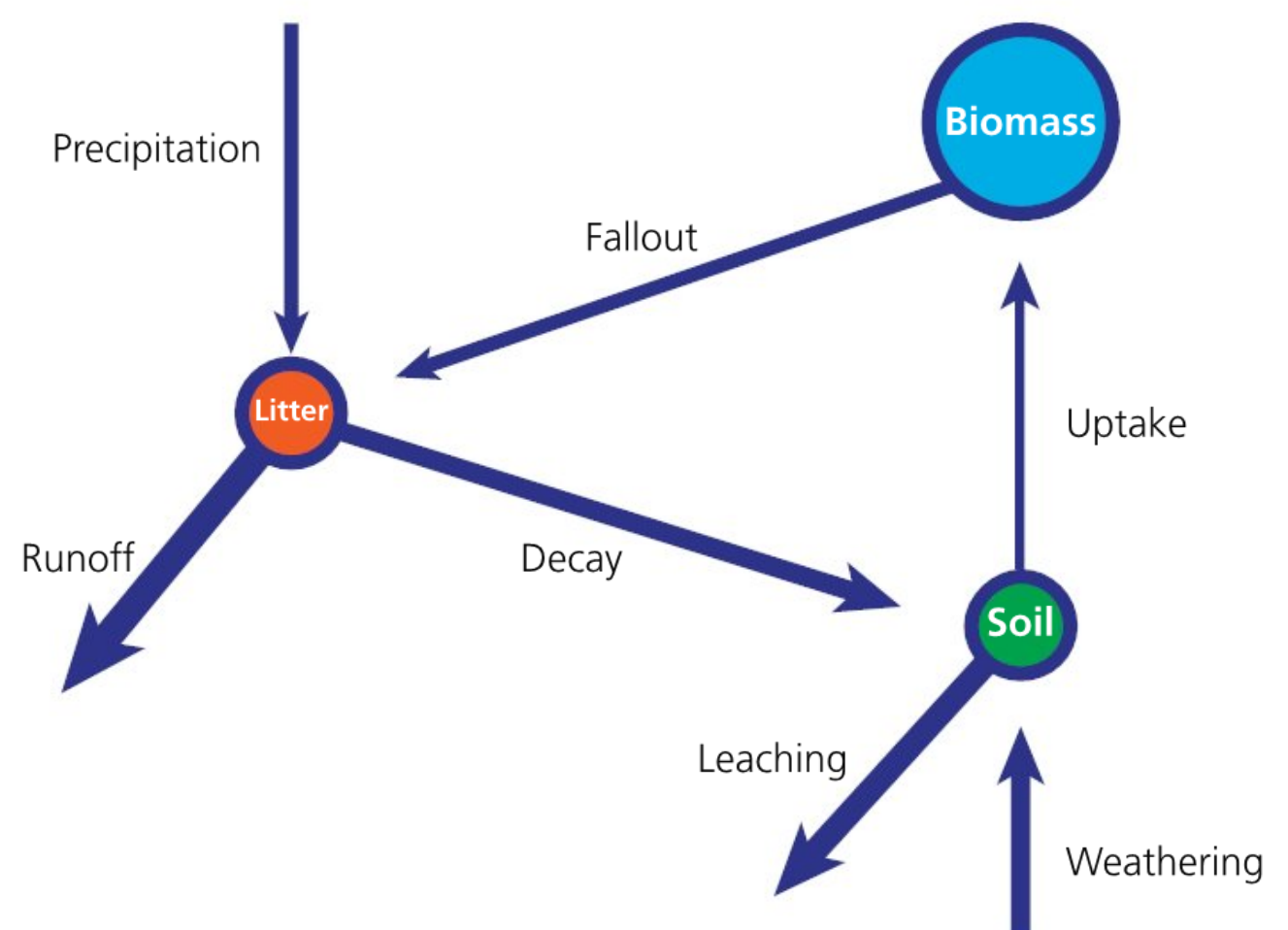
What changes are caused by the management of biomes?

So far in this chapter, we have looked into the processes within biomes, such as soil, food webs and nutrient cycles. In this section, we will be looking at how modern management can change these processes.

Normal rainforest



Managed rainforest



■ **Figure 6.33** A normal rainforest biome nutrient cycle and one that has experienced management

In Figure 6.33 you can see that the nutrient cycle in the managed rainforest has changed from its original state. The amount of nutrients stored in the biomass has reduced considerably and there are more nutrients being taken out of the system by leaching through the soil. The nutrient cycle suggests that there has been deforestation (the biomass reducing in size), which has led to more water getting to the soil, which in turn has meant that water has infiltrated and percolated down, carrying the nutrients with it. As the soil is already weak in the lower horizons, the small number of nutrients in the soil will be washed away.

THINK–PAIR–SHARE

Look at Figure 6.33.

Think about what processes have changed. In pairs, **discuss** why you think this change has happened. Share and **compare** your ideas as a class.

DISCUSS

Discuss why the nutrient cycle in the rainforest changes when the biome is managed and what you think will be the impact on the food web.

MYP Individuals & Societies by Concept 2 looked into the issues affecting people and the ecosystem in the Congo. These issues include deforestation, mining, road building, political instability, international interest in resources, and conflict. All these will have a profound impact on the biome. While some are obvious, such as deforestation, others such as conflict might not be.

EXTENSION

Suggest how conflict and political instability can change the processes within biomes.

Management in all biomes is very complex, and there will always be both negative and positive effects on the biome. The concept of feedback loops can help us to understand this. A feedback loop is when a change can have an effect on another part of the system, in this case, the food chain or web. Most feedback loops in the food chain are negative. This means that if the number of a species declines then the number of the species below it will increase. If these changes reach a stable state or balance point, this is known as the dynamic equilibrium; all trophic levels will be in balance with each other. However, if something changes in that system (food chain/web), then this changes the balance in the system.

A **positive** or **negative feedback loop** can occur when there are changes in the food web. In this context, positive does not mean positive in a good way and negative does not mean negative in a bad way, rather that the number of a species can increase or decrease. This will have a knock-on effect on the number of other species that either eat it or get eaten by it. For example, if the number of predators at the top of the food chain is reduced due to overpoaching, then the species in the trophic level below will not be kept in check (there will be fewer animals eating them). Their number will

therefore increase and so they will need to have more food in the trophic level below them. The number in the next trophic level will decrease due to being overeaten by the species above them, and so the system balance will be disturbed, and in turn, all the processes in the system can change. This can happen as a result of various management and intervention initiatives and in all biomes.

ACTIVITY: Changes in the processes due to human intervention

■ ATL

- Communication skills: Structure information in summaries, essays and reports

Answer the following questions on human intervention in both the tropical rainforest and the savanna grasslands:

- 1 **Define positive and negative feedback loops.**
- 2 **Using examples, explain how nutrient cycles can be affected by changes in the processes due to human activity.**
- 3 **Annotate a diagram showing how the trophic level of a food chain can be affected by poaching in the savanna grasslands.**
- 4 **Explain how a tropical rainforest food web can be changed due to deforestation.**
- 5 **Give some examples of negative and positive feedback loops in the tropical rainforest and savanna grasslands.**

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding.

Is it possible for management of biomes to be sustainable and equitable?

CASE STUDY: PALM OIL FARMING IN THE TROPICAL RAINFOREST



■ **Figure 6.34** Palm oil deforestation in south-east Asia

Many consumer products have palm oil as an ingredient, and it is increasingly used as a biofuel. However, the issues surrounding palm oil have been in the news for many years; the photo in Figure 6.34 has been used many times to show the plight of the orangutans in the rainforest. This case study will look into why we use palm oil in so many products, how it is produced and the impacts it has on the tropical rainforest biome. We will also consider whether and how farming for palm oil can be sustainable.

Most palm oil production comes from Indonesian and Malaysian rainforests. These countries depend on the revenue from palm oil to develop the country's economy. However, many farming practices have not been sustainable, in fact, many significant areas of the tropical rainforest have been wiped out to make way for the palm oil plantations, and according to the World Wide Fund for Nature (WWF), many species are becoming endangered, such as the orangutan, tigers, rhinos and elephants.

ACTIVITY

■ ATL

- Information literacy skills: Collect and analyse data to identify solutions and/or make informed decisions

- 1 Investigate** the different products that contain palm oil. You can do this as a class, as a group or individually.
- 2 Classify** the products into the following categories: Food, Household cleaning products, Cosmetics, Beauty products, Personal hygiene products (shampoos, etc).
- 3** For some products you have found, see if you can find palm oil free alternatives.
- 4 Produce** a poster to show your findings to the rest of the class if done as a group or individually, or to the school community if you worked as a class.
- 5 Have** a class discussion on 'Can we ever be palm oil free?'

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion: C: Communicating.

SOURCE A

Written by Martin Russell, 19 February 2018

Economical and versatile, palm oil has become the world's most widely used vegetable oil. However, its production comes at a heavy environmental cost, especially in Indonesia and Malaysia, the two main producers. Efforts to make its production more sustainable still have a long way to go.

Palm oil: a vital commodity

Oil palm trees are native to West Africa, but were introduced to tropical regions of Southeast Asia and Latin America in the late 19th century. Oil extracted from the fruit was traditionally used in Africa for cooking, but has now found a wider range of uses: as a substitute for animal fats such as butter in baked products, soaps and cosmetics, or as a basis for biodiesel. Around half of packaged products in supermarkets contain palm oil. Although palm oil is not particularly healthy (it contains higher levels of saturated fats than most other vegetable oils), it has many advantages: compared to soybean (the world's second most widely consumed vegetable oil after palm oil), it requires only one-tenth as much land, one-seventh as much fertiliser, one-fourteenth as much pesticide and one-sixth of the energy to produce the same quantity of oil, and is therefore very cheap. In addition, palm oil is highly resistant to oxidation, making it suitable for frying and giving it a long shelf life. As a result, consumption of palm oil has doubled over the past 15 years to nearly 8 kg per inhabitant of the globe, and shows no signs of slowing down. Until the 1960s oil palms were mainly grown in Africa, but since then production has shifted to Southeast Asia: according to FAO statistics, Indonesia (53% of global output) and Malaysia (29%) are the leading producers, followed by Thailand (4%), Nigeria (2.6%), Colombia (2.3%) and Ecuador (1%).

The economic and social impact of oil palm cultivation

Palm oil is the main agricultural export of Indonesia and Malaysia, generating 10% and 5% respectively of their exports. The sector provides employment for 721 000 smallholders and labourers in Malaysia, and 4 million in Indonesia; a further 11 million in the two countries are indirectly dependent on it. Most oil palm jobs are in remote rural areas, where alternative employment is scarce, thus helping to promote rural development and alleviate poverty. However, not all have benefited; in both countries, indigenous communities often lack legal documents certifying their ownership of land, and there are many legal conflicts between oil palm companies granted government concessions in forested areas, and the people who have used the land for centuries. In some cases, this has led to local people losing access to land and resources. As a result of such problems, in one survey nearly half

of 187 villages in Indonesian Borneo were opposed to palm oil companies. There are also serious concerns about abusive labour conditions on some plantations.

The environmental impact of oil palm

An even bigger concern is the environmental impact. A European Commission study (2013) estimates that between 1990 and 2008, 5.5 million hectares (an area nearly twice the size of Belgium) of forest were lost to oil palm plantations, including 3.1 million in Indonesia and 1.4 million in Malaysia. This process continues, with around half a million hectares of additional plantations in Indonesia, and 100 000 in Malaysia every year; much of this expansion is happening at the expense of the region's dwindling rainforests.

Deforestation is a major concern for several reasons. Compared to rainforests, palm oil plantations support only one-fifth as many animal species. By eating into the **habitats** of the orang-utan and Sumatran tiger (both critically endangered species) as well as numerous smaller animals, they threaten biodiversity. At the same time, oil palms have less than 20% as much above-ground biomass as rainforest trees, and a correspondingly lower capacity to absorb carbon dioxide from the atmosphere. That effect is exacerbated for the estimated one-third of Indonesian and Malaysian plantations located on waterlogged carbon-rich peaty soils. Draining such soils, which is necessary for the oil palms to grow, exposes the peat to oxygen, causing it to decompose and release huge quantities of carbon dioxide into the atmosphere. Peat drainage in Southeast Asia, largely in order to clear land for oil palms, is estimated to cause the equivalent of 2% of global fossil fuel CO₂ emissions.

Forest fires are another even bigger contributor to global warming and a recurrent environmental disaster in Indonesia. Such fires can occur naturally, but many are started deliberately – mostly by smallholders practising 'slash and burn' agriculture, but sometimes also by large plantation operators. In the dry season, fires can easily get out of control, destroying huge tracts of forest. Around one-fifth of such fires can be directly attributed to palm oil, which also contributes indirectly, given that drained peat soils burn easily, helping fires to spread.

Some of Indonesia's worst forest fires to date were in 2015. Over several weeks, Indonesia became the world's biggest emitter of greenhouse gases, as fires destroyed an area almost the size of Belgium. Choking haze spread as far as Singapore, costing the Indonesian economy at least US\$16 billion and causing as many as 100 000 premature deaths.

From: European Parliamentary Research Blog

ACTIVITY: Source analysis – the impacts of farming palm oil

■ ATL

- Communication skills: Write for different purposes
- Critical-thinking skills: Evaluate evidence and arguments
- Information literacy skills: Access information to be informed and inform others

- 1 Using Source A, give reasons why some governments and companies want to use palm oil.
- 2 Using the information from the source and your own knowledge, **describe** and **explain** how palm oil exploitation has changed the processes within the tropical rainforests of Indonesia and Malaysia.
- 3 Using Source A and your own research, complete the following:
You have been commissioned to write a report on the use of palm oil. You have been asked to make a decision on whether the use of palm oil should be allowed. You have to **explain** how palm oil is being used, **evaluate** the advantages and disadvantages of using palm oil and then make your final decision, with justifications.

Some websites to help with the research:

- <https://stories.undp.org/10-things-we-all-should-know-about-indigenous-people>
- www.survivalinternational.org/
- <https://epthinktank.eu/2018/02/19/palm-oil-economic-and-environmental-impacts/>
- www.worldwildlife.org/pages/which-everyday-products-contain-palm-oil
- www.theguardian.com/environment/2018/jun/26/palm-oil-disastrous-for-wildlife-but-here-to-stay-experts-warn
- <https://rspo.org/certification>

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding and Criterion D: Thinking critically.

Countries such as Indonesia and Malaysia depend on palm oil to develop their country; many countries depend on palm oil for cheaper products. But how can we make palm oil production less harmful to the rainforest and for all who live there? With the numerous issues surrounding how sustainable the farming of palm oil is in these countries, many are pushing for more ethical and sustainable farming methods that are still compatible with economic development. This includes protection of land for wildlife as well as the local and indigenous people.

! Take action: Raise awareness of our impact on fragile environments

- ! Using the links in the activity on this page, raise awareness in your school community about the importance of biodiversity and indigenous peoples in many biomes. **Discuss** how our consumption of certain products (such as palm oil in the rainforest) is creating environmental degradation in many biomes. **Present** alternatives to using certain products that are destroying the last wilderness biomes.

Reflection

In this chapter, we have **identified** where and why biomes are located in certain regions around the world, and we have **explained** the processes that affect the location of biomes. We have **investigated** how people, plants and animals have adapted to the climate and how parts of the tropical rainforest have been destroyed for our consumption of products such as palm oil. We have **taken action** by informing our community about the impacts of such management schemes and **evaluated** how we can manage the biomes in a more sustainable way.

Use this table to reflect on your own learning in this chapter.					
Questions we asked	Answers we found	Any further questions now?			
Factual: What are biomes and where are they located? What are the main factors affecting biome location?					
Conceptual: What are the main processes in a biome? How have plants and animals adapted to their biomes? How have indigenous people adapted to their biomes? What changes are caused by the management of biomes?					
Debatable: Is it possible for management of biomes to be sustainable and equitable?					
Approaches to learning you used in this chapter:	Description – what new skills did you learn?	How well did you master the skills?			
		Novice	Learner	Practitioner	Expert
Communication skills					
Critical-thinking skills					
Information literacy skills					
Learner profile disposition	Reflect on the importance of being principled for your learning in this chapter.				
Principled					

7

In what ways does globalization affect us?



Globalization is a worldwide exchange, the effects of which in individual countries may be fair or unfair.

CONSIDER THESE QUESTIONS:

Factual: What is the pattern of global trade? What are the main types of international flows? What is aid?

Conceptual: What is globalization? What are the patterns in global interactions? How can global trade be fair for all?

Debatable: Has global trade failed poor countries? Is aid an effective strategy for ending poverty? Should cultural exchanges be seen as a positive or negative product of globalization?

Now **share and compare** your thoughts and ideas with your partner, or with the whole class.

IN THIS CHAPTER, WE WILL ...

- **Find out** what the pattern of global interactions and trade is, how world trade is driven by international flows and what the different types of aid programmes are.
- **Explore** who the trade winners and losers are; the links between trade and development and the differences between cultural diffusion and cultural imperialism.
- **Take action** to consider the value of sociocultural exchanges and their importance in today's society.

These Approaches to Learning (ATL) skills will be useful ...

- Communication skills
- Creative-thinking skills
- Critical-thinking skills
- Information literacy skills
- Organizational skills
- Transfer skills

We will reflect on this learner profile attribute ...

- Knowledgeable – we will explore knowledge across a range of disciplines, engaging with issues and ideas that have local and global significance.



■ **Figure 7.1** The first IKEA store in India, opened in August 2018 in the southern city of Hyderabad

◆ Assessment opportunities in this chapter:

- ◆ Criterion A: Knowing and understanding
- ◆ Criterion B: Investigating
- ◆ Criterion C: Communicating
- ◆ Criterion D: Thinking critically

KEY WORDS

aid	interactions
culture	flow
development	trade

DISCUSS

What do you know about globalization? Brainstorm.

Watch this short video: <https://youtu.be/wF0wMFKwiQU>

Can you **define** globalization?

What is globalization?



■ **Figure 7.2** A map of the Silk Road in Uzbekistan

Globalization is the process by which the world has become more connected and interdependent. Through easier circulation of people, goods, money and information, an increasing percentage of the global population is more integrated into the global economy and is more aware of the rest of the world than ever before. Globalization is not a new concept. From 114 BCE to around 1450 CE, China traded across the African and Eurasian land masses via the Silk Road, a network of interconnected terrestrial and maritime trade routes, allowing China to export its silk production as well

as religions, philosophies and technology. Globalization is a process in constant evolution, going through different phases. In the 1990s and the early 2000s, the process accelerated, with economies becoming more interdependent; however, since the global financial crisis in 2008, the amount of global trade has levelled off (see Figure 7.3). Some experts argue that globalization has now entered a new phase with an increasing spread of information. Global communication is increasing not only in speed but also in density, and it does not show any signs of slowing.



ACTIVITY: Defining the concept of globalization

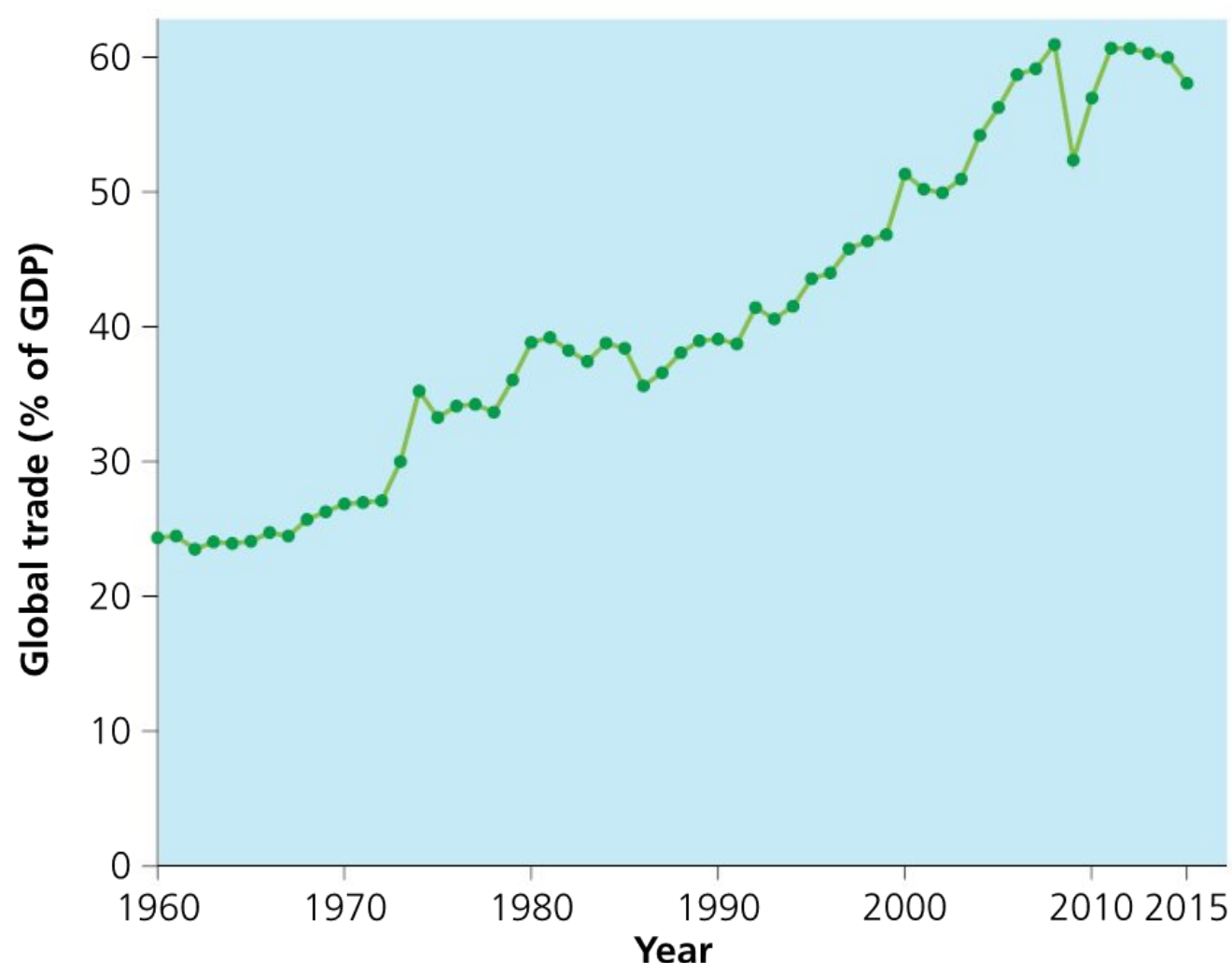
■ ATL

- Transfer skills: Combine knowledge, understanding and skills to create products or solutions

- 1 Individually, research sources and news articles related to the concept of globalization. Try to find definitions and views from a range of sources.
- 2 Create a Venn diagram to summarize information from your sources, making sure that the non-overlapping areas of the circles show contrasting views about the concept. In the overlapping area, write the common views and understanding about the concept of globalization.
- 3 In pairs, compare the views in your Venn diagrams. Discuss the extent to which they are similar. Working in small groups, try to agree on a joint definition of globalization which takes into account more than two views.
- 4 Share your definitions with the rest of the class. What are the similarities and differences between the range of definitions? As a class, agree on the most suitable definition.

◆ Assessment opportunities

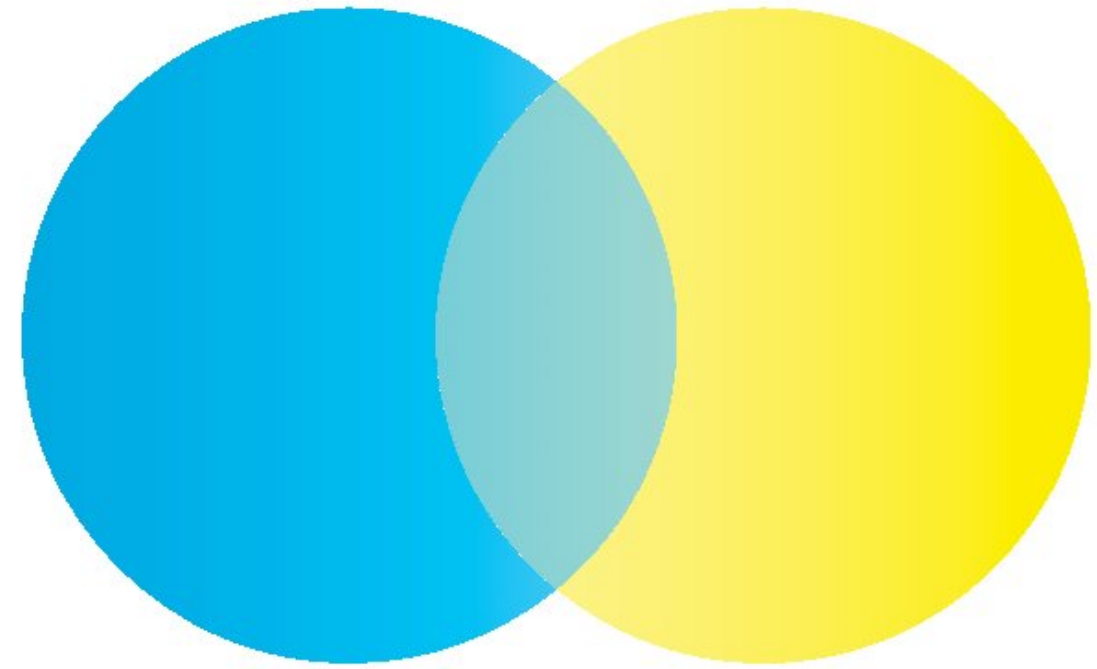
- ◆ This activity can be assessed using Criterion A: Knowing and understanding.



■ Figure 7.3 Global trade since 1960

Venn diagrams and mind maps

A **Venn diagram** is a type of graphic organizer. It is a way of organizing complex relationships visually and making abstract ideas more visible. A Venn diagram consists of overlapping circles. Each circle contains all the elements of a set. The area where the circles overlap shows the elements that the sets have in common. Generally, there are two or three circles.



■ Figure 7.4 Venn diagram

A **mind map** is a graphical way to represent ideas and concepts. It helps to structure information and allows you to better **analyse**, comprehend, **synthesize** and **recall** information, and to generate new ideas. The starting point should be a central concept or idea. It can be helpful to use an icon or image of some kind in the centre of your mind map. The 'branches' out from the central idea should then introduce concepts or ideas that are related to the central idea but of slightly less importance. These branches eventually break into twigs with more related ideas or sometimes examples. Mind mapping takes you from a big picture to details in a structured way and can be a good way to organize arguments.

THINK–PAIR–SHARE

Individually, think about what makes a globalized place or country.

Share your ideas with a partner and agree on at least four key features of a globalized place or country.

Share with another pair and try to agree as a group on the four most important features of a globalized place or country.

Was it easy or not to come up with the top four features? Why?

What are the patterns in global interactions?

DISCUSS

The KOF Globalisation Index is a multiple index which combines economic, social and political indicators.

Do you think some indicators might be seen as more important than others? Which indicator do you think would be given more attention by experts when assessing how globalized a country is? **Justify** your decision.

In the previous activity, we have seen that defining globalization is a challenging task. It is also a very controversial concept with some seeing it as a fairly positive process while others regard it as mainly negative with multiple adverse effects. The controversy around globalization stems partly from the fact that for many years there was no general agreement on how best to define it. In the early 2000s, several leading economic **think tanks** developed methodologies aiming to identify the nature and the essential features of globalization. In 2002, the KOF Swiss Economic Institute created the KOF Globalisation Index, which measures the main dimensions of globalization. The index is used to assess changes in the rate of globalization of 185 countries over certain time periods.

The three dimensions of globalization measured by the index are:

- Economic globalization, which covers both trade flows and financial flows as well as services.
- Social globalization, which comprises a wide range of indicators. It includes a measure of interpersonal contacts such as international telephone connections, tourist numbers and migration, a measure of information flows characterized by international patent applications, trade in high technology goods, access to TV and international internet connections. Cultural proximity is also included in social globalization and it is expressed as the trade in cultural goods, international trade mark registrations or the number of global chains, such as McDonald's restaurants or IKEA stores.

DISCUSS

In pairs, look at Figure 7.5, which shows an IB school in Antwerp, Belgium.

To what extent is a school like the one in the photograph a good illustration of globalization?

Discuss with reference to the dimensions of globalization.



■ **Figure 7.5** A leading IB school in Antwerp

- Political globalization, which is measured by the number of embassies and international non-governmental organizations (NGOs), along with membership of international organizations and international treaties.

The total index measures globalization on a scale of 1 to 100. The figures for the various dimensions that make up the index are expressed as percentiles.

Choropleth mapping

A choropleth map is one where the amount of colour, or the density of the shading, represents variations in the data being presented. The data are usually in the form of a ratio, for example, population density per square kilometre.

This allows you to **compare** places that are very different in size, as it shows the density of people rather than how many people there are in the area. The data must be grouped into classes, and the boundaries of each class must be **stated** in a key.

Five classes usually works best. To **calculate** the class interval carry out the following calculation:

$$\text{highest value} - \text{lowest value} / \text{number of classes}$$

ACTIVITY: The Globalisation Index

■ ATL

- Transfer skills: Combine knowledge, understanding and skills to create products or solutions

Your goal is to research the three dimensions of globalization.

- 1 In groups of three, **explore** the three dimensions of globalization using ArcGIS Online. Open a new ArcGIS Online map and **search** the layer *Dimensions of globalization*. Once this has been added to your map, your map content should look like Figure 7.6.



■ **Figure 7.6** Dimensions of globalization

(See page 19 if you need to remind yourself how to add layers on ArcGIS Online.)

- 2 Each group member is to **explore** one dimension only:
 - Student 1 – economic globalization: financial flows, consumption of goods, TNCs, transport

- Student 2 – social globalization: cultural diffusion, spread of information, migration
- Student 3 – political globalization: military interventions, political and economic groupings, role of the UN, international aid

- 3 Improve the map visualization for your chosen dimension using ArcGIS Online to create choropleth maps. These maps will make it easier to **analyse** the global pattern of your particular dimension. (See pages 20–22 if you need to remind yourself how to change the map design and symbols on ArcGIS Online.)
- 4 **Describe** what your map shows and **explain** why it is relevant for the definition of globalization.
- 5 **Present** your findings to the rest of the group. You can do this by sharing your map layer.
- 6 As a group, reflect on the following points with help from your GIS maps:
 - Are the top globalized countries also the top-ranking countries in all three dimensions?
 - Discover which countries have a top economic rank but are at the bottom politically. How can you **explain** this pattern?
 - Are the three dimensions of globalization equally important in the overall Globalisation Index of individual countries? **Justify** your views with evidence.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.



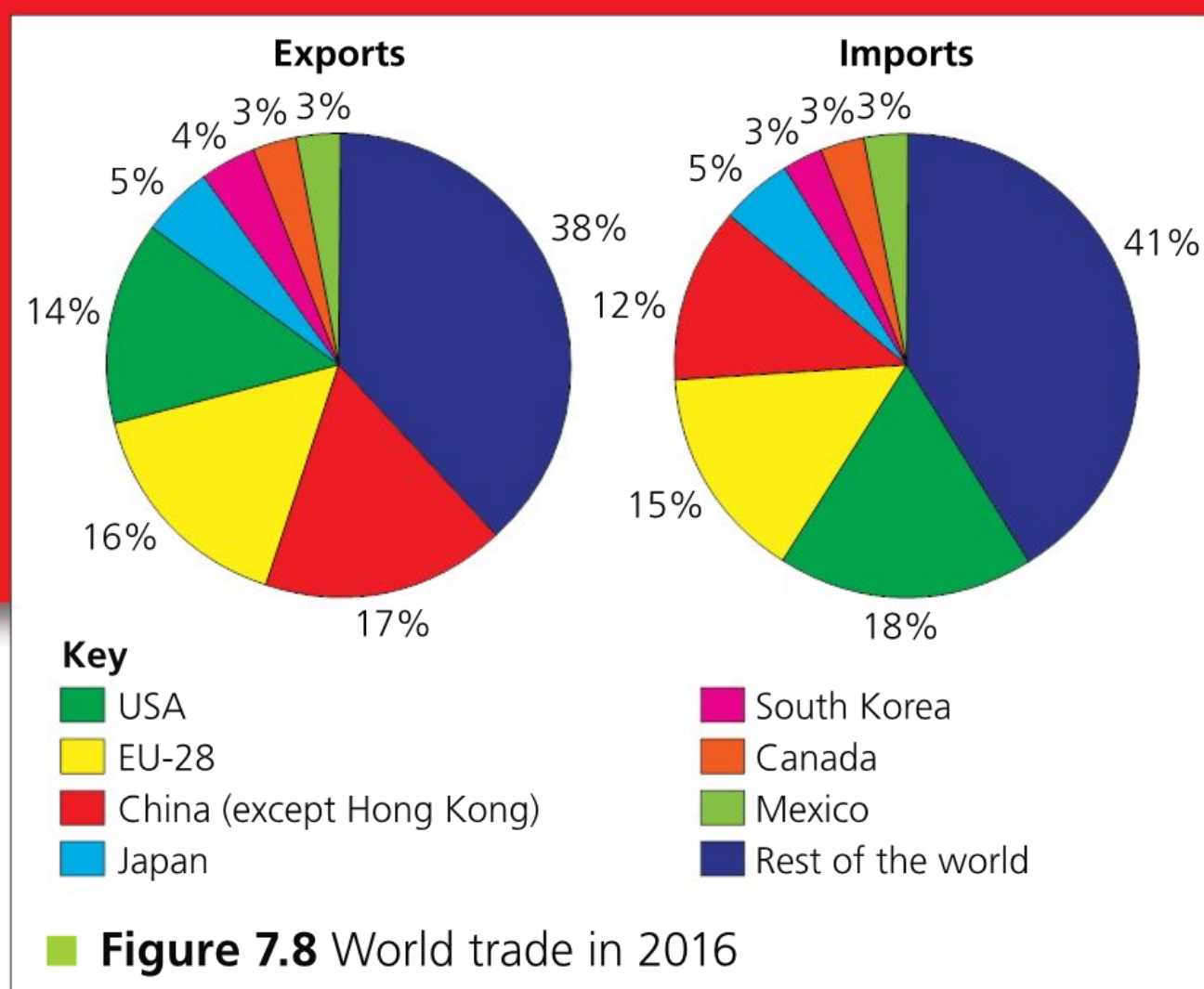
EXTENSION: EXPLORE FURTHER

Explore further the indices and variables used for calculating the Globalisation Index.

Research the sort of data used in the measure of economic, social and political globalization.

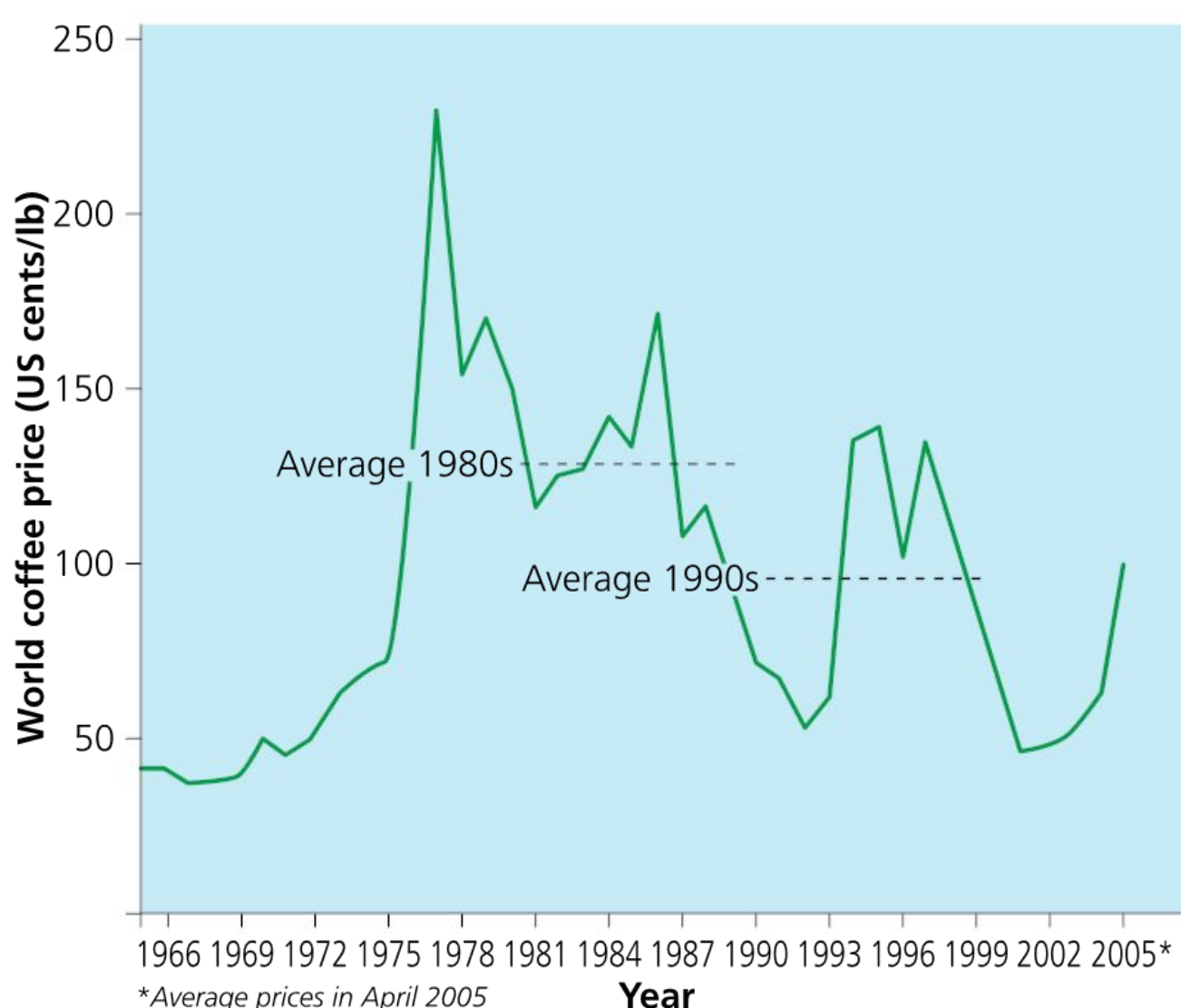
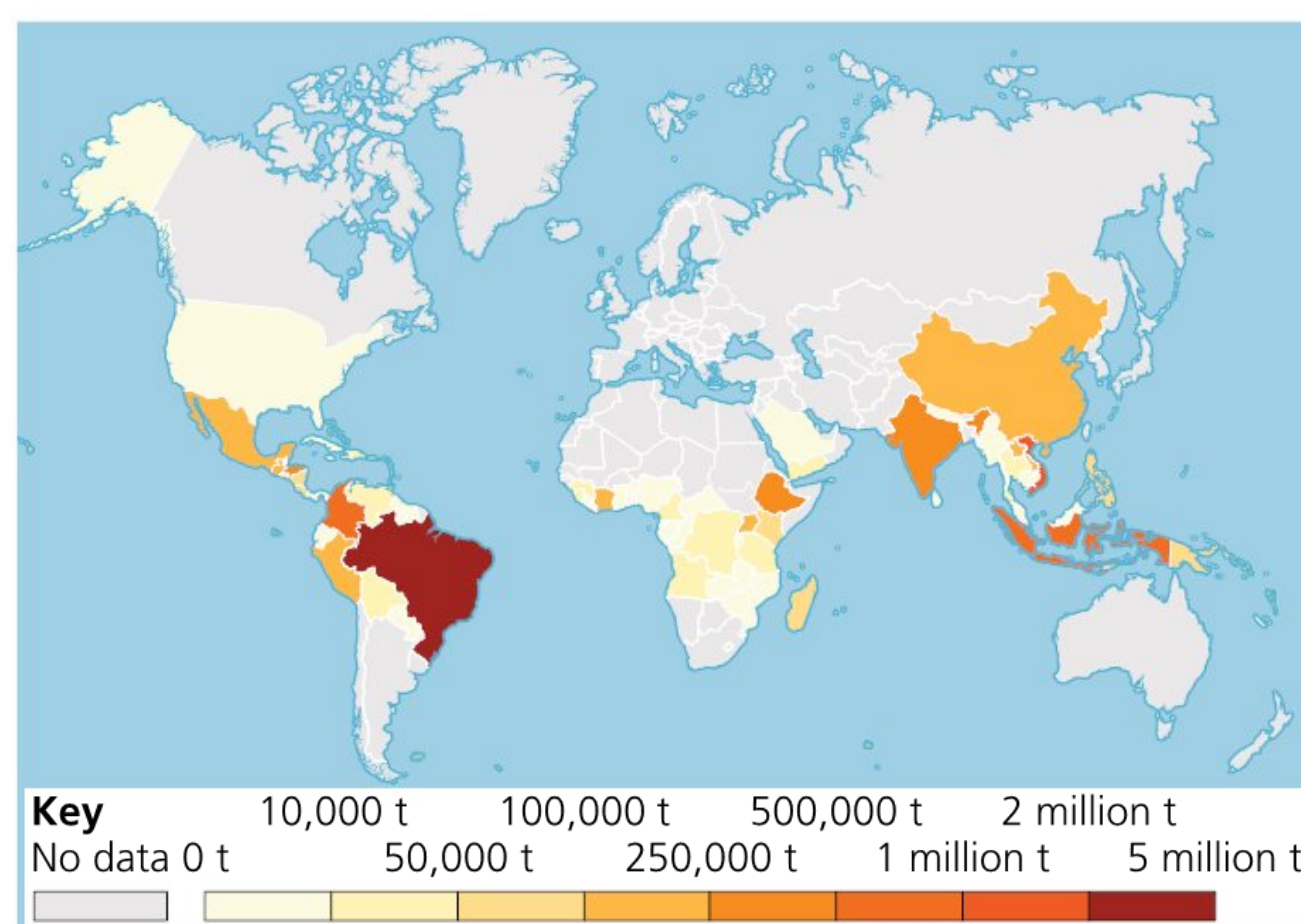
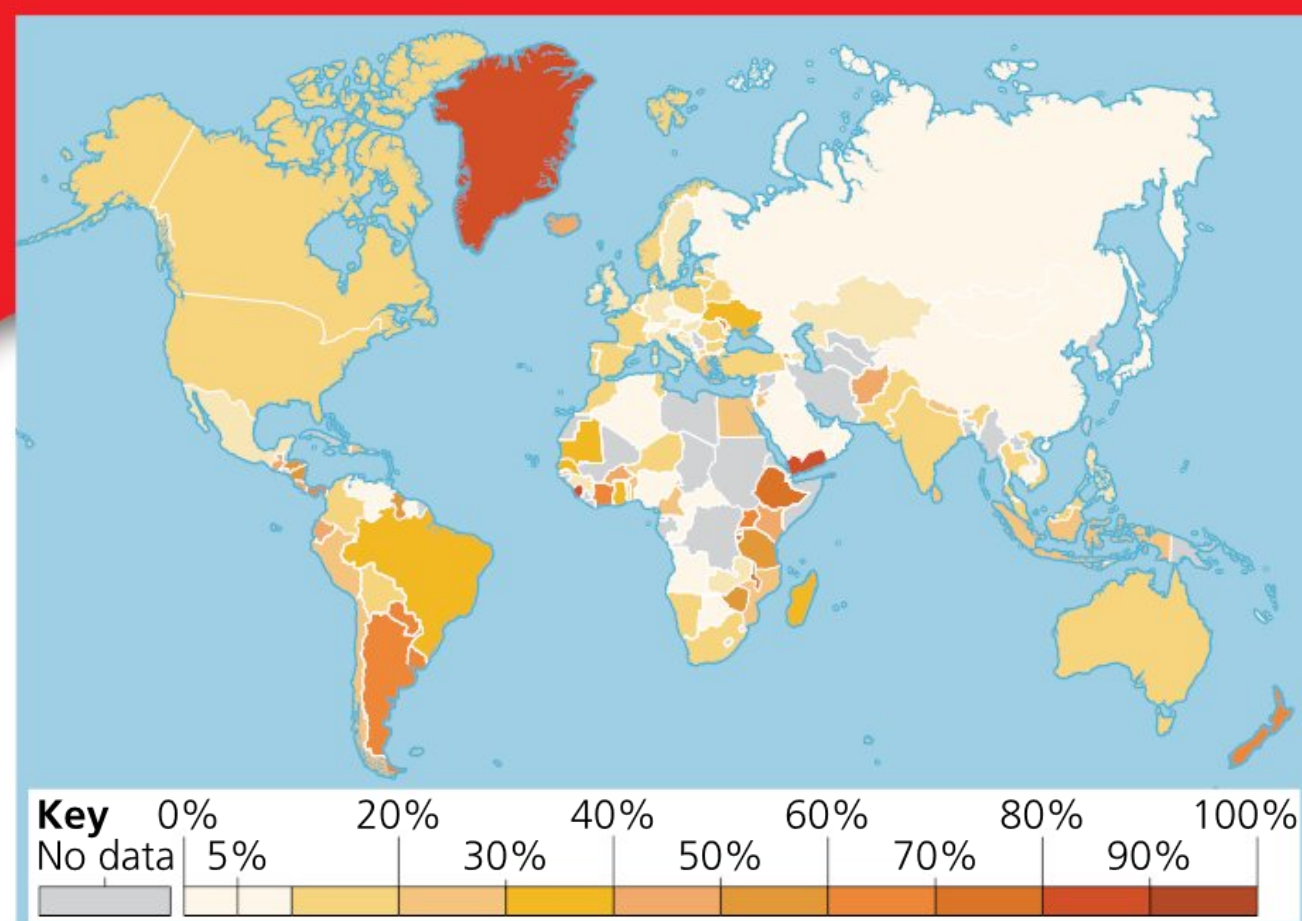


■ **Figure 7.7** A choropleth map of population density in Antwerp, Belgium



WHAT IS THE PATTERN OF GLOBAL TRADE?

International trade takes place when a country sells or exports its commodities, goods or services to another country. Countries tend to export what they can produce easily and in large quantities due to certain geographical factors and abundant natural resources (see Chapter 5, page 92). This is the founding principle of the **comparative advantage theory**, which states that a country should specialize in what it is good at and then trade for products with another country that specializes in different products so that both countries benefit from trade. One country's exports therefore become another's imports. The difference between exports and imports is called the **balance of trade**. Nations with a positive balance or trade surplus tend to benefit economically and get wealthier. Countries with a negative balance or **trade deficit** may build up debts and get poorer. International trade is dominated by a small number of nations (see Figure 7.8) that benefit greatly from the value of global trade. For many other nations, the pattern of trade can be an issue when their exports consist mainly of commodities or primary products (see Figure 7.9). The value of trade linked to primary products is significantly lower than the value of trade from manufactured products. Some countries become poorer because of this, which hinders their development. In the next activity, we will investigate some fundamental issues resulting from the pattern of world trade by analysing elements of the coffee trade.



ACTIVITY: The pattern of international trade

■ ATL

- Information literacy skills: Collect, record and verify data; Make connections between various sources of information

In this activity you will work individually to **analyse** the pattern of international trade and then work collaboratively to **suggest** reasons why trade can be an obstacle to development.

- 1 Individually, **describe** the pattern of world trade as shown in Figures 7.8 and 7.9.
- 2 In pairs, **describe** and **explain** at least three issues faced by countries which are dependent on exports of primary products such as coffee (Figures 7.10 and 7.11).
- 3 Research the trade balance of at least two countries that are mainly involved in commodity exports. Use these websites to help you:
Commodity exporters: <https://atlas.media.mit.edu/en/profile/hs92/0901/>
Trade balance: <https://tradingeconomics.com/country-list/balance-of-trade>
- 4 **To what extent** is their trade balance a hindrance to development? Are all developing countries in the same situation? **Discuss** in pairs and then share your thoughts with the rest of the class.

◆ Assessment opportunities

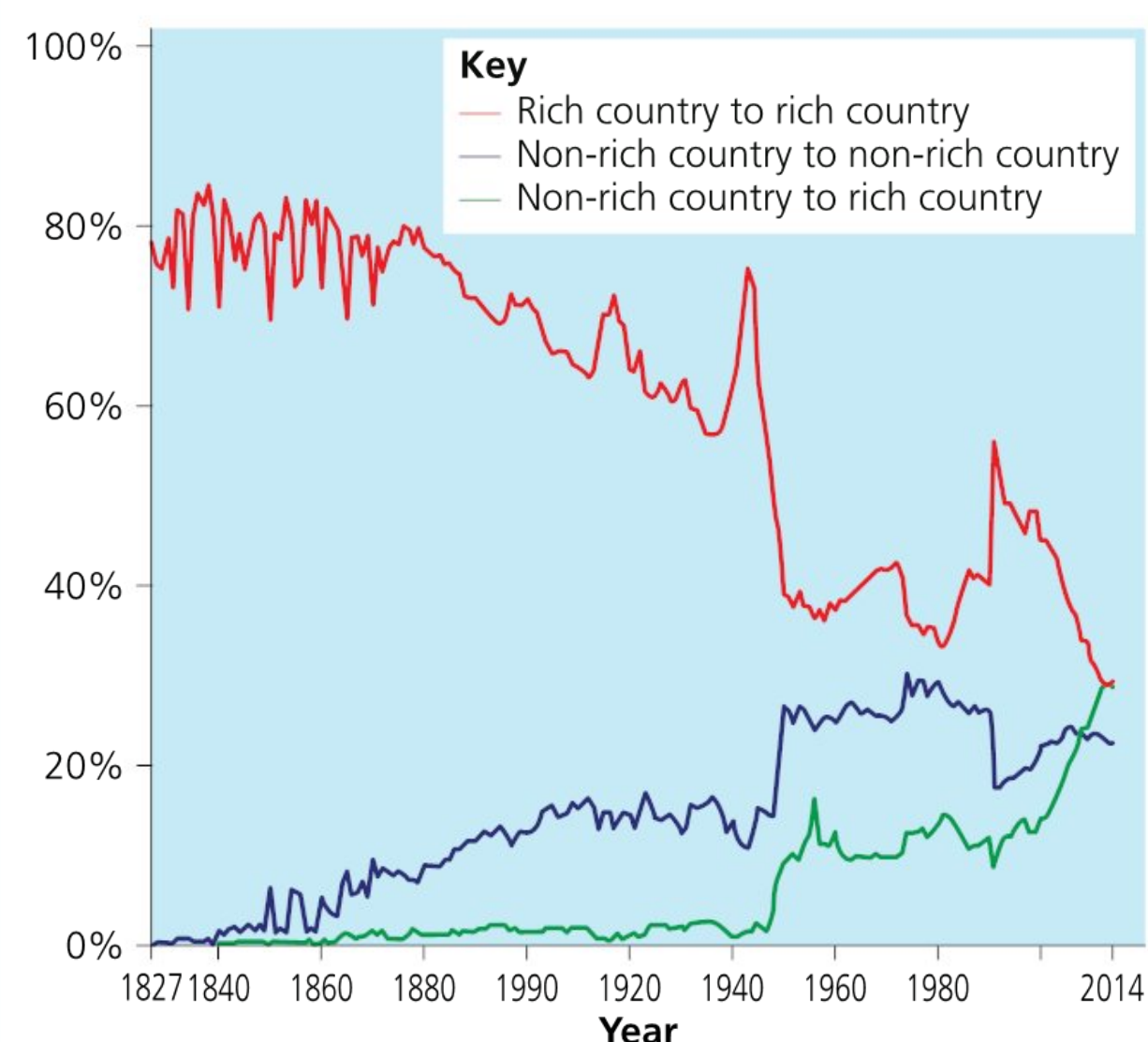
- ◆ This activity can be assessed using Criterion A: Knowing and understanding and Criterion D: Thinking critically.

ACTIVITY

■ ATL

- Critical-thinking skills: Interpret data

Study the graph in Figure 7.12.



■ **Figure 7.12** Share of world trade in merchandise (% global exports)

What do you see? Make sure you **describe** the graph as accurately as possible. Can you **identify** a trend in the graph? What historical events and geographical processes may help to **explain** the trend since 2000?

Research

Search the definition for **North–South divide**.

Discuss the extent to which Figure 7.12 challenges the definition of the North–South divide.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.

How can global trade be fair for all?

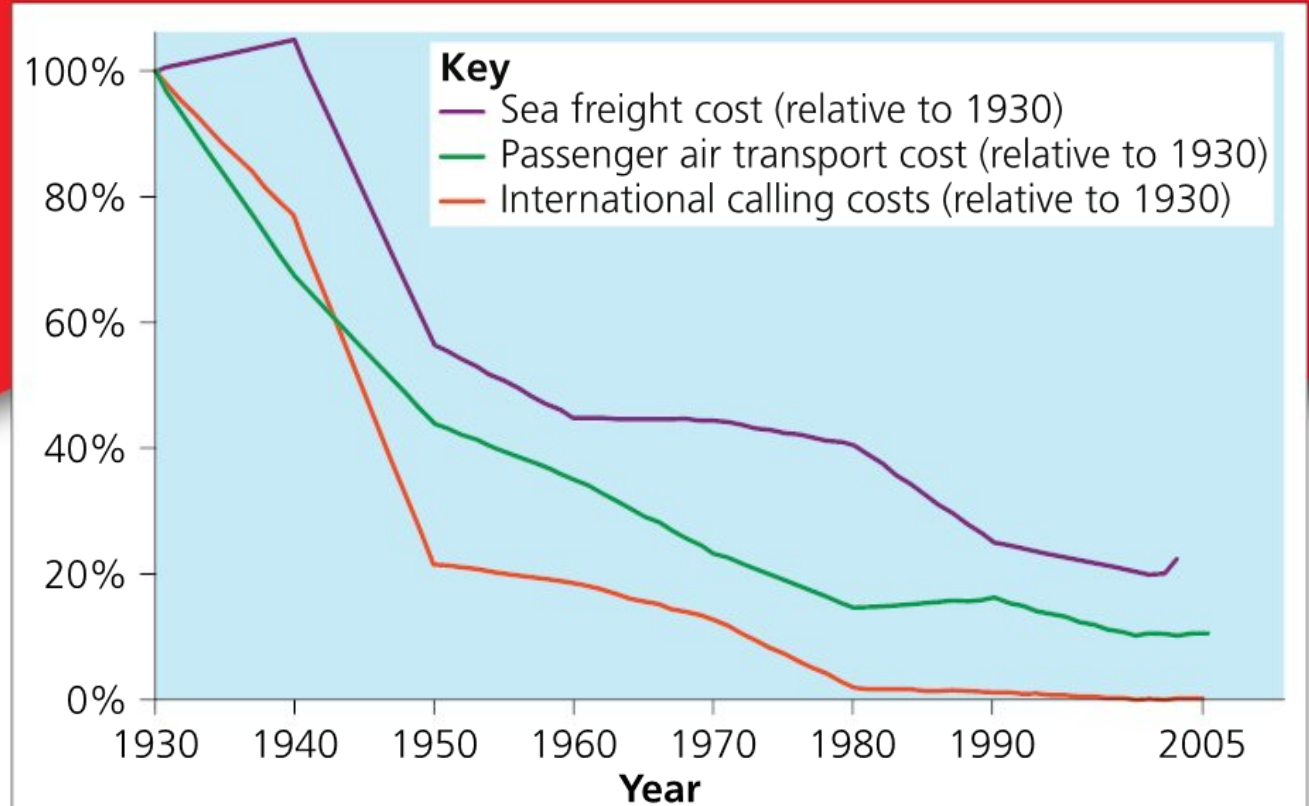


Figure 7.14 Decrease in the cost of transport by type

DISCUSS

Discuss the cartoon in Figure 7.13 with a partner.

What is the cartoon telling us about free trade?



Figure 7.13 A cartoon about free trade

In Figure 7.3 we saw that international trade has continued to grow sharply since the 1960s. Up until the 1990s most trade was dominated by wealthier countries and multinational corporations. Developed countries often seemed to have an unfair advantage despite international efforts from the World Trade Organization (WTO) to regulate trade by setting trade rules, and by limiting **subsidies** **quotas** and tariffs. More recently, as a result of globalization, developments in transport and communication (see Figure 7.14) and an increasing number of preferential trade agreements have enabled more trade and exchanges between developing nations (see Figure 7.12). In the following activity, we will investigate the main causes of unfair trade.

ACTIVITY: The causes of unfair trade

■ ATL

- Creative-thinking skills: Apply existing knowledge to generate new ideas, products or processes

Create a spider diagram or a mind map to **show** the causes of unfair trade.

Use the following website to help you carry out your research: www.bbc.com/education/guides/z3666sg/revision/1

Search **unfair trade causes** to **find** additional sources to help you complete your diagram.

You could use the following headings for your diagram:

- Dependency on commodity export
- Balance of trade
- World market
- Tariffs
- Dumping
- Trading bloc
- Globalization

Try to **show** links between different parts of your diagram. Draw arrows between causes that you think are linked.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding, Criterion B: Investigating, Criterion C: Communicating and Criterion D: Thinking critically.

DISCUSS

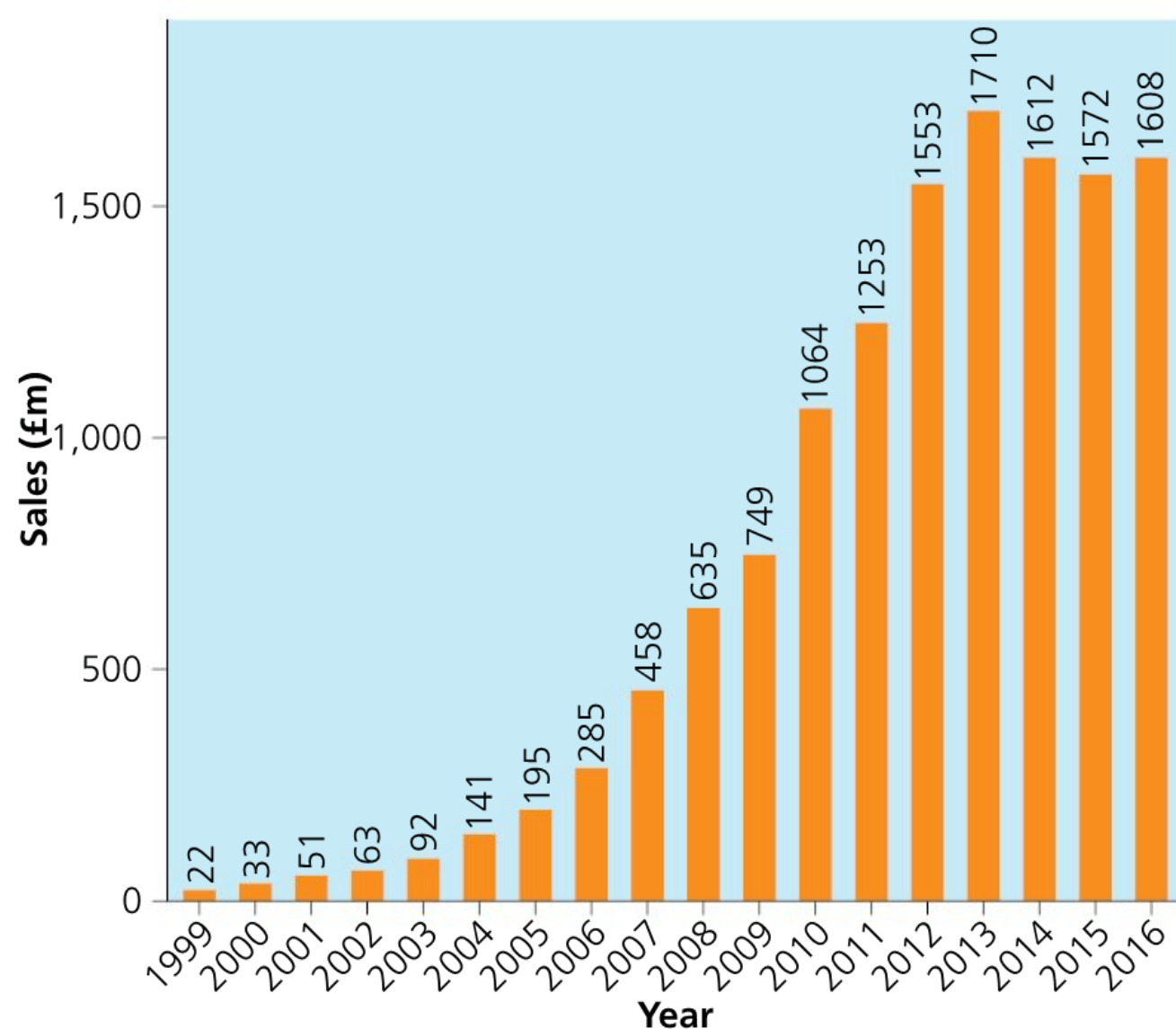


Figure 7.15 A South Africa and China diplomatic relations event, January 2018

In pairs, consider the extent to which the photo in Figure 7.15 supports the trends shown in the graph in Figure 7.12.

Justify your views with photographic evidence.

Fair trade is an alternative to conventional trade. The system connects producers directly to consumers by reducing the number of intermediaries. When smallholders and their workers trade on fair trade terms, they receive a minimum guaranteed price and better working conditions. Fair trade agreements also aim to empower rural communities by increasing local participation in the scheme. This provides opportunities for improving the lives of people in developing nations and enables them to plan for their future. Fair trade is an effective way of reducing poverty and therefore achieving Sustainable Development Goal 1: *End poverty*. Could the ethical nature of fair trade consumption explain why it has grown so rapidly over the last decade and particularly in the UK (see Figure 7.16)?



Take action: Campaigning for a fair trade breakfast

ATL

- Creative-thinking skills: Create novel solutions to authentic problems
- Communication skills: Negotiate ideas and knowledge with peers and teachers

What is your goal?

- ! Your goal is to campaign successfully to persuade more students from your school to consume fair trade produce for breakfast.

How will you achieve this?

- 1 As a class, brainstorm the following questions:
 - ◆ What are you trying to change?
 - ◆ Why is it important to support fair trade products?
 - ◆ Are you raising awareness about fair trade overall, or are you campaigning for a specific fair trade group in one particular country?
 - ◆ Do you have all of the facts you need? If not, can you **find** the most reliable sources of information?
 - ◆ Have you got a plan? Can you put several campaign teams together?
 - ◆ Who else outside your class can help you achieve that change?
 - ◆ What will your campaign look like? Who is your target audience?
 - ◆ What would make your campaign really successful? Would organizing a fair trade breakfast at your school make a difference?
- 2 Formulate a plan of how you will conduct your campaign.
- 3 Once you have completed your campaign, evaluate the planning, the process of running your campaign and its outcomes. If you were to run another campaign, what would you change?

Assessment opportunities

- ◆ This activity can be assessed using Criterion B: Investigating and Criterion C: Communicating.

Figure 7.16 Sales revenue from fair trade products in the UK

ACTIVITY: Fair trade: Is it really fair?

■ ATL

- Communication skills: Use a variety of speaking techniques to communicate with a variety of audiences
- Critical-thinking skills: Gather and organize relevant information to formulate an argument

As a class, you are going to prepare for a debate **discussing** whether fair trade is really fair.

Recently, fair trade has attracted a certain amount of criticism. Your goal is to debate the effectiveness of the scheme and to **suggest** constructive changes to the fair trade culture and model so it continues to make a difference in people's lives. The proposed changes will be debated in front of a committee from the WFTO (World Fair Trade Organization).

Research

The class will be divided in two:

- One group will take **stakeholder** roles of fair trade campaigners, farm workers/owners and food businesses. There should be an equal number of fair trade advocates who are in favour and fair trade critics who want to change the scheme. According to their roles, this group should search **fair trade advocate** for arguments in support of the current fair trade scheme and **fair trade critics** for arguments against the current fair trade scheme and in favour of a change.
- The other group will take on the roles of members of the WFTO, organized into a committee in charge of reviewing the scheme.

This group should visit <https://wfto.com> to learn more about the WFTO and **explore** the organization's key objectives and challenges. They should take research notes, which will be used to inform the committee's decisions during the debate.

Performance

- Stakeholders should write a speech (no longer than two minutes) from the point of view of their character. Clearly indicate if you are in favour of a change or not and give reasons using specific evidence and examples. Use your best arguments and try to be convincing!
- WFTO committee members should remain in role with an awareness of the challenges facing fair trade. Do not hesitate to challenge the presenters!

Success criteria

The committee should vote on whether or not a change is needed and write a short statement outlining the proposed changes.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding and Criterion C: Communicating.

EXTENSION

Explore conflicts between fair trade advocates, fair trade critics and the WTO further by completing a conflict matrix (see page 15).

CASE STUDY: TRADE WINNER – SOUTH KOREA

SOURCE A

South Korea signs free trade deals with five Central American countries

SEOUL (Reuters) – South Korea said on Wednesday it is signing free trade agreements with five Central American nations aimed at boosting market access for the Korean auto sector and electronics makers.

Trade minister Kim Hyun-chong will meet representatives from Costa Rica, El Salvador, Honduras, Nicaragua and Panama in Seoul on Wednesday to sign five separate bilateral pacts which

will eliminate duties on about 95 percent of traded goods and services, Korea's trade ministry said in an e-mailed statement.

The agreements are subject to parliamentary approval in each country, and is likely to take effect at different times depending on the ratification process.

The five trade pacts open South Korea to key Central American countries after its deals with the U.S., the European Union and China helped boost exports.

'The South Korea–Central America free trade deals will enable the countries to build more comprehensive, strategic partnerships going forward,' Kim said.

The ministry expects the five deals to accelerate South Korea's economic growth by an overall 0.02 percent in the next 10 years, by boosting exports of cars, steel, cosmetics products, and auto components.

From www.reuters.com, 21 February 2018



■ **Figure 7.17** A car factory assembly line in South Korea

CASE STUDY: TRADE LOSER – BRAZIL

SOURCE B

Brazil's reliance on commodity exports threatens its medium- and long-term growth prospects.

While Brazil's economic performance in the past decade has made it one of the leading targets of foreign investment in the world, its success has relied heavily – even excessively – on commodity exports, mostly destined for China. Exports have grown to \$256 billion, up from \$118 billion in 2005, and now account for 14 percent of GDP (compared to 6 percent in the 1990s).

Mineral, agricultural and other primary products constitute more than 50 percent of Brazil's total exports. But it was not always that way. Exports of manufactured goods were once Brazil's cash cow, commanding a higher value than primary and semi-manufactured goods combined. But as its agriculture sector grew, Brazil became one of the world's leading exporters of soy, sugar, meat, coffee, tobacco, and orange juice. Over the past seven years, the value of commodity exports has quadrupled.

Should Brazil's new dependence on commodities be a reason for concern? The growth that was fueled by commodity export success has improved Brazil's financial health, and certainly helped the nation weather the 2008–2009 global financial crisis. Yet heavy reliance on commodities has created significant challenges that threaten the economy's medium- and long-term prospects.

For starters, favorable commodity prices may be short-lived. The 2000s were an atypical decade with regard to consistently high prices, largely due to China's emergence as a global economic power. Brazilian exports to China grew at roughly four times the rate of total exports between 2000 and 2010. Chinese imports of soy, for example, represent over 40 percent of Brazil's exports, while Chinese imports of iron constitute over a third of the total exports in the sector. Oil, pulp and paper, and meat are also substantial exports to China, representing from 5 percent to 10 percent of Brazil's exports of these products.

Commodity prices tend to be quite volatile. Economies tied to them become so, too: when prices are high, the economy booms. But when they fall, the contraction can be severe. And there are already signs of contraction in China.

As Chinese growth rates have begun to slow and global commodity prices start to fall globally, so have the volume and value of Brazilian exports to China. Depending on how severe China's slowdown is – and whether other nations step in to fill the void – Brazil's overemphasis on commodities could prove dangerous not just to the country's short-term fiscal health, but also to its long-term prospects for economic stability and development.

If commodity prices start to fall and the good times recede, will there be enough of a manufacturing sector to fill the void? Will Brazil's labor market have the skills necessary to compete with other developing nations in alternative industries? Or will it be too late to catch up? With Chinese growth slowing, we may know the answer soon. But if historical experience and current trends are any indication, it will be difficult to break the cycle.

From www.americasquarterly.org, summer 2012



■ **Figure 7.18** Mass soybean harvesting in the state of Mato Grosso, Brazil

ACTIVITY: Trade winners and losers case studies

■ ATL

- Information literacy skills: Access information to be informed and inform others
- Communication skills: Structure information in summaries, essays and reports

In this activity, you will research an example of trade, in commodities, manufactured goods or services, for a specific country or group of countries. Start by choosing a trade from the box below.

- 1 Brainstorm the potential positives and negatives of your chosen trade. Use your ideas to help you come up with a research question. You may find the following website useful to begin your research:**
<https://atlas.media.mit.edu/en/>
- 2 Formulate an action plan of how you will carry out your research.**
- 3 Evaluate your research methodology and results.**
- 4 Create a case study which answers your research question, based on a detailed example of one type of trade involving one or several countries. Make sure all your sources are cited using recognized conventions.**
- 5 Present your case study to the class. Use a suitable presentation format, allowing the rest of the class to make notes about your case study. Your aim is to give clear evidence on whether the trade you have researched brings positives, negatives or both to the country or countries involved.**

Possible case studies for trade in commodities:

- Palm oil in Indonesia
- Bananas in the Caribbean
- Green beans in Kenya

Possible case studies for trade in manufactured goods:

- Garment industry in Bangladesh
- Cars in South Korea
- Electronic goods in China

Possible case studies for trade in services:

- Tourism in Kenya
- Outsourcing from India

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion B: Investigating and Criterion C: Communicating.

HAS GLOBAL TRADE FAILED POOR COUNTRIES?

In 2001, the World Trade Organization (WTO) attempted to put the needs of less developed countries at the centre of the international trade negotiations at the Doha conference in Qatar. Nearly a decade later, the WTO had to admit that the negotiations had failed due to constant disagreements between main global trade partners. For example, the USA, the European Union, Brazil, India, Japan and Australia could not agree on a fair trade deal on agriculture. India and Brazil complained that the USA and the EU were too demanding in their desire to access new manufacturing markets in those countries in exchange for cutting farm subsidies and tariffs. Developing countries had been completely ignored in favour of what were considered to be more crucial global economic and political concerns.

The most significant issue for developing countries is that free trade is not equally accessible. There are many reasons why global trade is failing poorer nations, for example:

- Protectionist economic policies restrict imports by using quotas and make imports more expensive due to tariffs.
- Agricultural subsidies, which are paid to rich nations' farmers, cause farming overproduction and make it cheaper to export, which threatens the livelihoods of farmers in poor nations.
- Trade agreements allow the poorest countries to be partly controlled by the rich nations. The EU has negotiated Economic Partnership Agreements (EPAs) with numerous African countries, forcing them to eliminate tariffs on up to 80 per cent of imports from the EU in exchange for receiving full duty-free, quota-free access to the European market.
- The global trade of medicine is impacting on life expectancy in developing nations. In poor countries, the majority of medicines are bought by individuals rather than the state (the opposite is true in most rich countries). Valuable medicines that keep people well enough to earn a living, contribute to a country's economic development and bring up children, are totally out of reach.

Global trade has failed to live up to its promises. Meaningful solutions to global economic problems can only come when the global interactions between countries are more about cooperation than competition.

ACTIVITY: Are global trade and development compatible?

■ ATL

- Communication skills: Read critically and for comprehension; Make inferences and draw conclusions; Structure information in summaries, essays and reports
- Organizational skills: Plan short- and long-term assessments; Meet deadlines
- Critical-thinking skills: Draw reasonable conclusions and generalizations

Write an essay, with reference to your own knowledge and Sources A and B (see pages 164–65), on the following:

'Global trade is responsible for a widening wealth gap between rich and poor nations.' **To what extent** do you agree with this claim?

You have one hour to complete the task.

You can focus on any countries you like, providing you include contrasting case study examples from different economic regions, for example, the EU, North America, West Africa or East Africa, South East Asia.

You could make use of the essay organizer on page 113 to help you plan.

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding, Criterion C: Communicating and Criterion D: Thinking critically.

What are the main types of international flows?

DISCUSS

Visit the websites below:

- www.theguardian.com/world/ng-interactive/2014/aviation-100-years
- www.bbc.com/future/story/20140130-how-air-travel-shrunk-the-globe

How has air travel contributed to the reduction of the friction of distance and subsequently to a shrinking world? **Discuss**

THE TIME–SPACE CONVERGENCE

WHAT MAKES YOU SAY THAT?

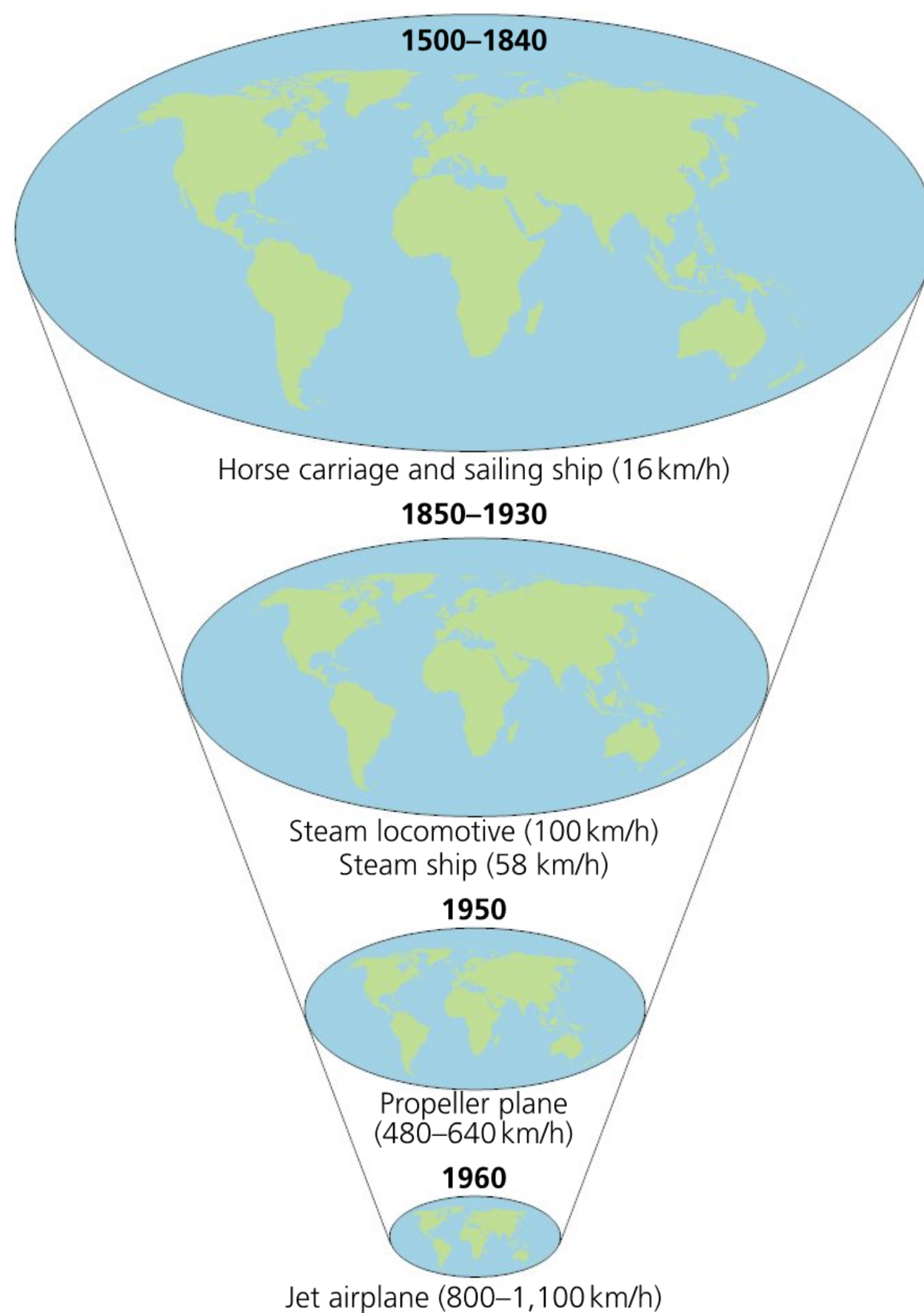
To **find** out more about the transport and communication revolution during the twentieth century, watch the following documentary:

<https://youtu.be/JwnzY2pxt4I>

- Which inventions made the world smaller? How did they achieve this?
- What makes you say that?
- What impacts have technological innovations in transport and communication had on the world?

International flows could be seen as the most visible aspects of globalization. The continuous increase in international flows of finance, people and information has contributed to an acceleration in time–space convergence. Time–space convergence is the decline in travel time between different places as a result of innovations in transport or communication technology, which have resulted in a reduction of the friction of distance. The friction of distance is a well-established geographical concept where travel, and therefore distance, has to overcome potential obstacles (friction), such as mode of transport, energy or cost, which will affect the time it takes to complete a journey.

Time–space convergence is often referred to as the ‘shrinking world’ process (see Figure 7.19). The combined effects of improvements in transport, especially the development of long-haul flights (see Figure 7.20) and the explosion of telecommunication, making people increasingly more aware of places and events worldwide, have accelerated the time–space convergence.



■ **Figure 7.19** Time–space convergence



■ **Figure 7.20** An airbus on approach into St Maarten airport in the Caribbean

ACTIVITY: Investigating our shrinking world

■ ATL

- Information literacy skills: Collect, record and verify data
- Critical-thinking skills: Gather and organize relevant information to formulate an argument; Consider ideas from multiple perspectives

What is your goal?

In this activity, you will **investigate** the changing relationship between time and space. Think about the concept of time–space convergence. There is a high probability that you have travelled more often and greater distances than your parents did when they were your age and far more than your grandparents at a similar age.

How will you achieve this?

You are going to **design** a questionnaire to collect primary data about your friends' and family's past and present travel experiences. You will also collect reliable secondary data. You will **present** and **analyse** your results in order to answer the following research question:

- 'How has the decrease in travel times and the decline in the significance of distance resulted in a time–space convergence?'

You could use the inquiry organizer on page 26 to guide you through your investigation.

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding, Criterion B: Investigating and Criterion D: Thinking critically.

HOW DO FINANCIAL, LABOUR AND INFORMATION FLOWS CHANGE DUE TO GLOBAL INTERACTIONS?

Throughout its different phases, from the nineteenth century and the advent of **imperialism** to the new millennium and the spread of the internet connecting individuals around the world, globalization has resulted from the coming together of new business practices, new technologies and new migrations. Evidence of this convergence can be seen on global flow maps for different stages of the globalization process. In 1890, the spread and importance of the British Empire can be seen through its global trade routes map (see Figure 7.21). The value of trade passing along each of the maritime routes was worth several million pounds per year even at that time. The flow of capital resulting from this trade was already significant and a key barometer of the economic success of the empire.



■ **Figure 7.21** A map of the British Empire, showing commercial trade routes

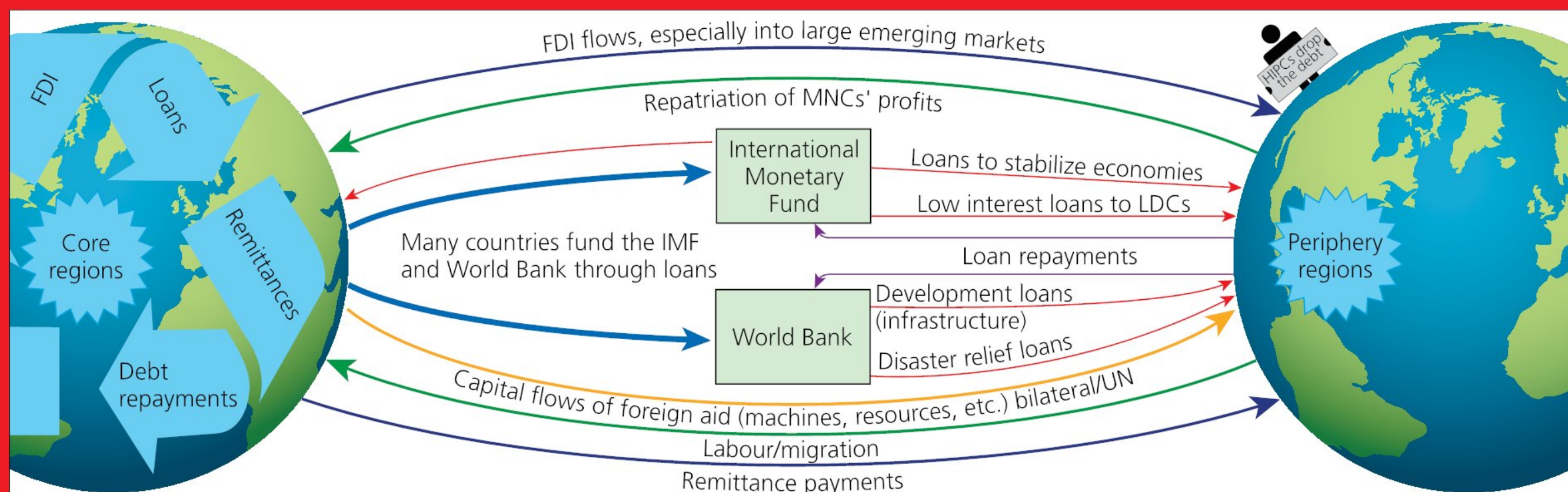


Figure 7.22 The different forms of financial flows

Today, international financial flows are at the heart of the interdependence of our globalized economy. There are several types of financial flows. Capital is the wealth owned by a person or an organization, which may be available for starting a company or investing. Successful capital investments in other countries sometimes lead to major repatriation of profit flows. Loans are sums of money lent to individuals, businesses or countries that are expected to be paid back with interest, often resulting in significant debt repayments for developing nations. The final type of financial flow takes the form of remittances, which are sums of money sent back to their home country by economic migrants (see Figure 7.22).

The international flow of people is another fundamental indicator of the geopolitical and economic context of the world. Our planet is currently experiencing the biggest movement of people since the Second World War. Table 7.1 summarizes the main causes and types of migration.

Voluntary migration	Forced migration
Economic migrants: people who move for employment opportunities and improved standards of living.	Environmental refugees: people who have to resettle in a different region or country after a natural hazard (see Chapter 10).
Illegal immigrants: people who move to another country without official permission to do so.	Political refugees: people who move as a result of political persecution or war.
Social migrants: people who retire to a different country with a better climate or quality of life, or who move due to changes in personal circumstance (marriage, joining relatives or friends).	Internally displaced: people who are forced to leave their homes and seek refuge elsewhere, sometimes just over a border.
Asylum seekers: people who seek to enter another country claiming to be victims of persecution, hardship or for other reasons.	

Table 7.1 Reasons for voluntary and forced migration

In 2018, almost one in five of the world's migrants were living in the top 20 largest cities. Many pull factors encourage people to move to urban areas while push factors, such as lack of food or jobs, or the effects of climate change, may force people to move. People living in rural areas, especially in developing countries, have high aspirations for their future and may have unrealistic perceptions of what cities can offer. Migration to cities, whether internal or international, primarily takes place because migrants hope for better job opportunities, better housing, and improved access to food sources and services.

In its 2018 Global Migration Trend report, the International Organization for Migration (IOM) concluded that the large majority of international migrants in the world are migrant workers. Most migrant workers are employed in services, followed by manufacturing and construction; agriculture accounted for the rest. The total number of global refugees is the highest on record, although the annual rate of growth has slowed since 2012.

DISCUSS

Visit this website:

<http://metrocosm.com/global-immigration-map/>

To what extent is the global migration map on this website a good illustration of voluntary migration?
Discuss.

THINK-PAIR-SHARE

Read Source C. Consider to what **extent** this quote is a good illustration of the process of globalization.

SOURCE C

'When I was growing up, my parents told me, "Finish your dinner. People in China and India are starving." I tell my daughters, "Finish your homework. People in India and China are starving for your job.'"

Thomas Friedman, New York Times

In 1997, 69 WTO member countries, representing 90 per cent of the global market, signed a multilateral agreement for opening national telecommunication markets to foreign investments and participation. Since then, competition between large multinational corporations has driven an explosion in global media and communication. The dominance of the mobile phone has not only replaced fixed telephone networks but it has also contributed to connecting people across regions of the world where fixed lines were never possible, especially in developing countries (see Figure 7.23). Since the 1990s, the internet has transformed trade, scientific research, education and entertainment. In 1993, there were 14 million internet users worldwide; in 2015, there were over 3.22 billion (see Figure 7.24). Europe and North America combined represent 25 per cent of the world's internet users while Asia has 48 per cent of world share. In Chapter 5, we explored how MNCs have benefited from improvements in information and communication technologies through an expansion of outsourcing.

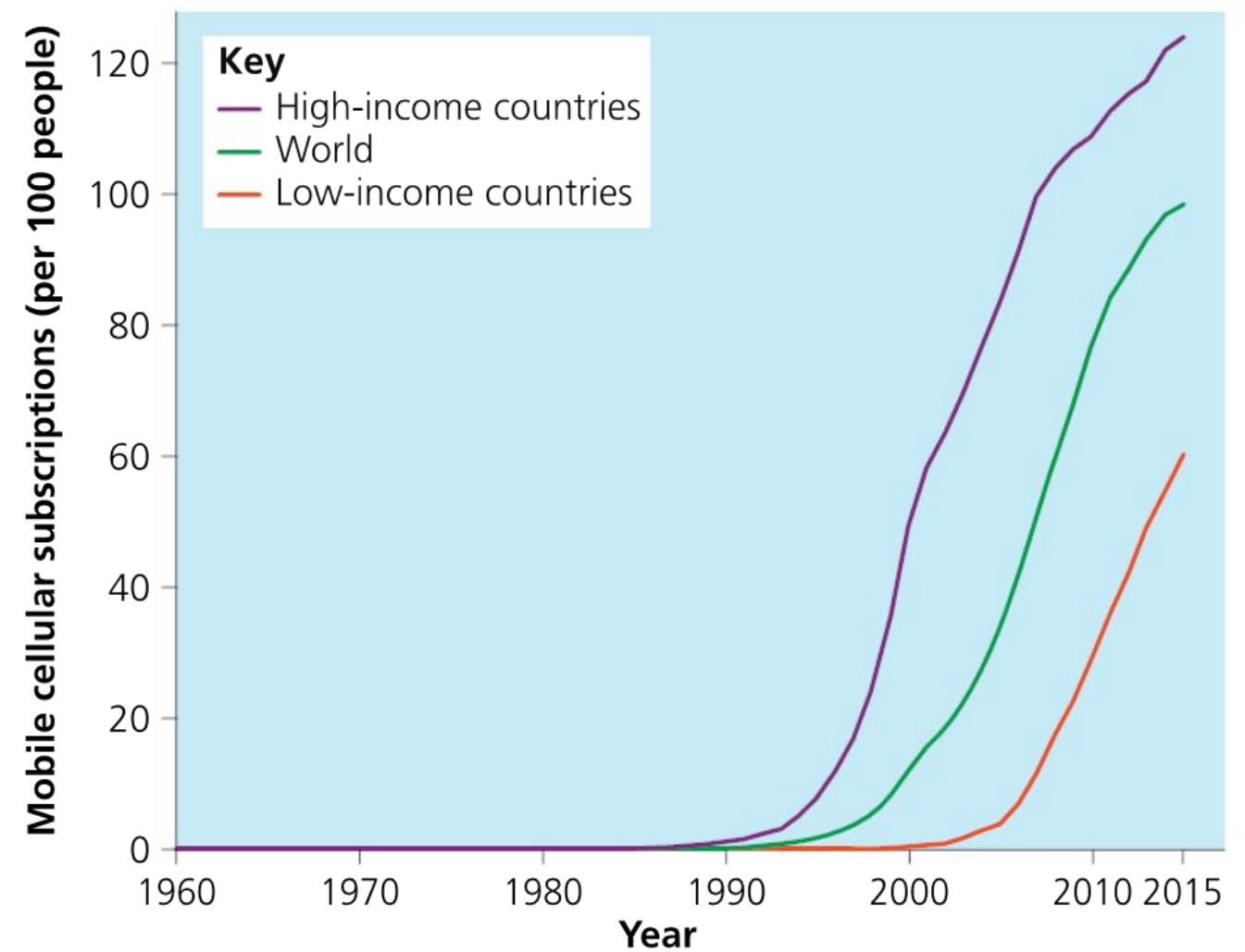


Figure 7.23 Mobile cellular subscriptions (per 100 people)

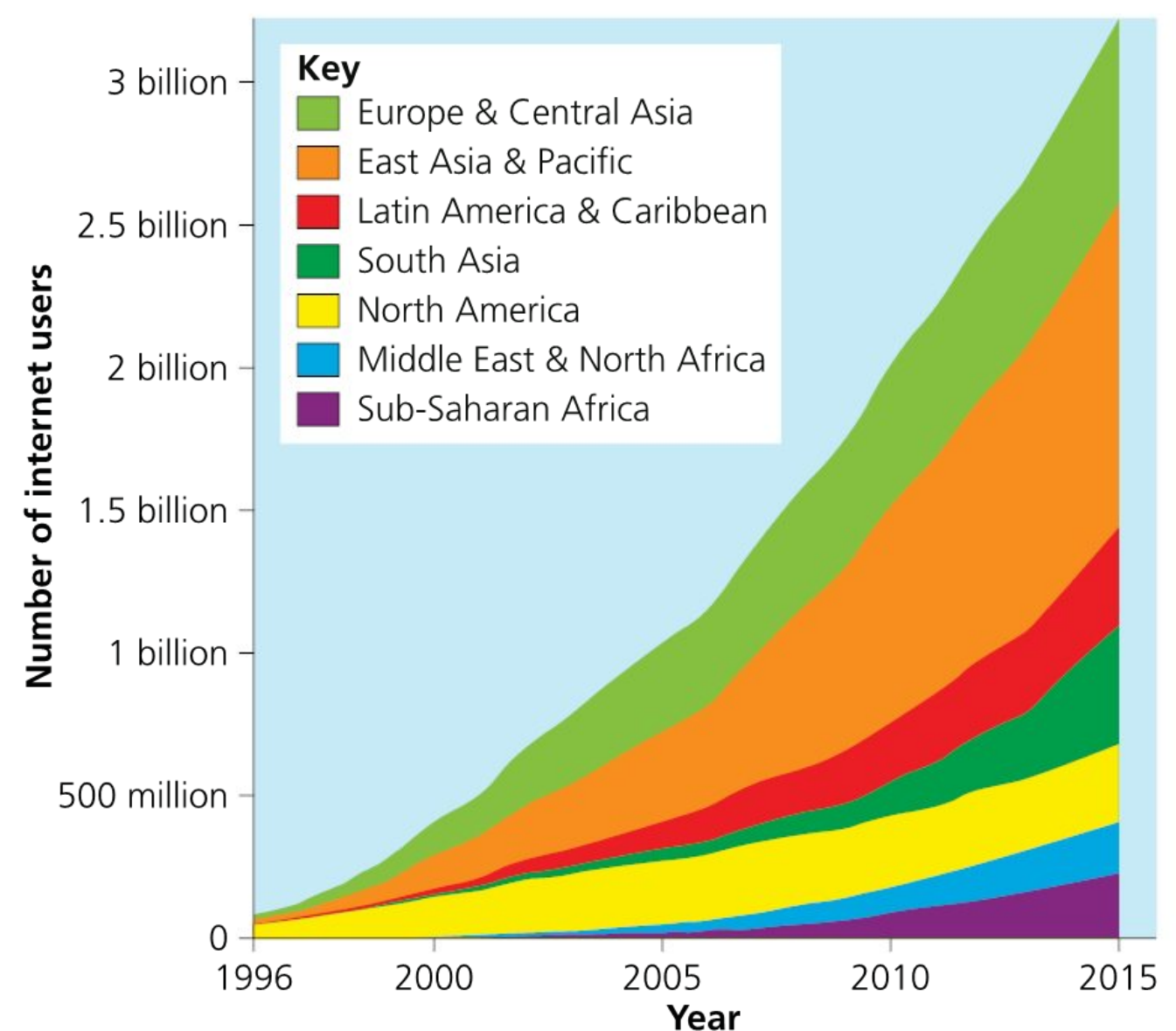


Figure 7.24 Internet users by world region, 1996–2015

Is aid an effective strategy for ending poverty?

WHAT IS AID?

SEE–THINK–WONDER

Study the photo in Figure 7.25.



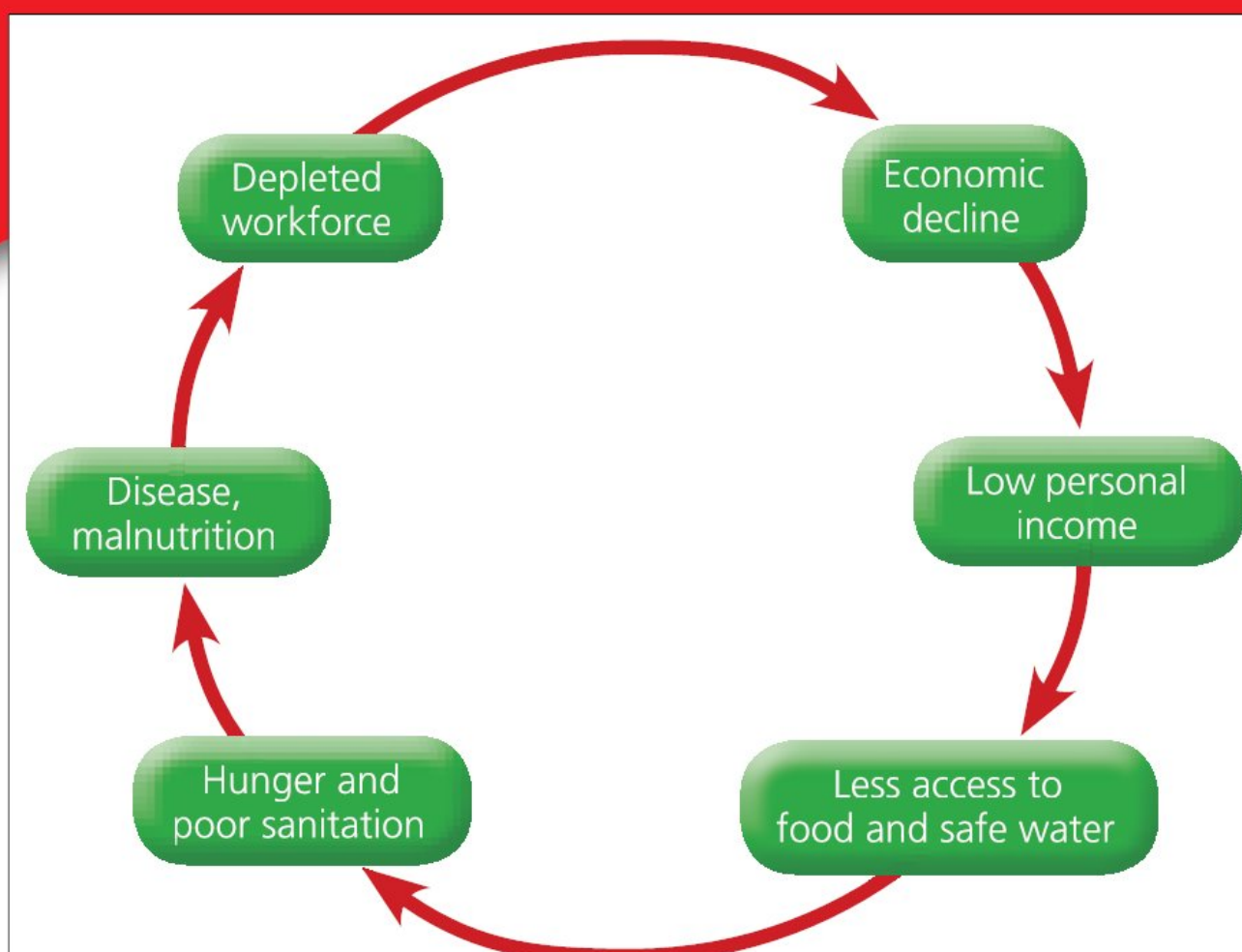
■ **Figure 7.25** Stacked up containers from the charity ShelterBox

What do you see? Make sure your description of the containers is as detailed as possible.

What do you think may be the purpose of these boxes?

What does this make you wonder?

Alongside climate change, reducing the disparities between the richest and the poorest nations is one of the biggest challenges facing the world. Aid is one way to help break the poverty cycle (see Figure 7.26) and allow communities to recover from disasters and conflicts. There are five main types of aid: bilateral aid, multilateral aid, voluntary aid, emergency aid and development aid (see Figure 7.27). Aid can consist of goods, such as food, medical supplies or machinery, which are sent to places in need.



■ **Figure 7.26** The poverty cycle



■ **Figure 7.27** Development aid helping to provide a water pump in northern Mozambique

In most cases, however, aid is financial, in the form of investment in development projects or in the form of loans. In 2017, foreign aid from the governments of richer countries totalled US\$ 146.6 billion. The global distribution of foreign aid as shown in Figure 7.28 clearly indicates that sub-Saharan African countries and the Indian subcontinent remain the main recipients of international aid. Clusters of aid recipients can also be found in Central and South America and some parts of Eastern Europe. Since 2010, the proportion of donor's cost for refugees has seen a marked increase with a peak in 2016 (see Figure 7.29 – 'in-donor refugee cost' is the cost of assisting refugees when they settle in a new country). The following activities will investigate the different types of aid and explore case studies to understand the reasons behind different types of aid programme and their levels of success.

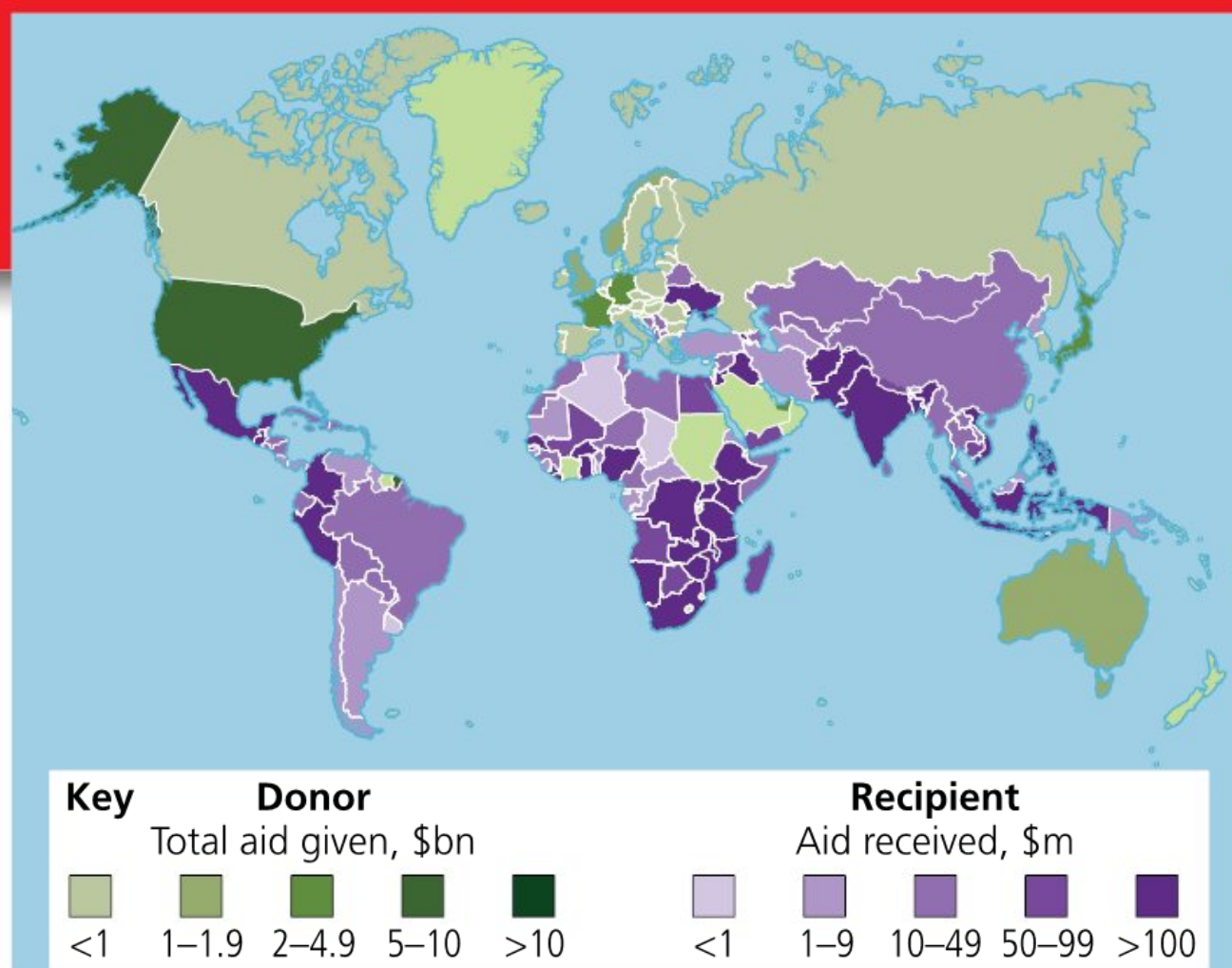


Figure 7.28 Foreign aid by country in 2014
Source: *The Economist*

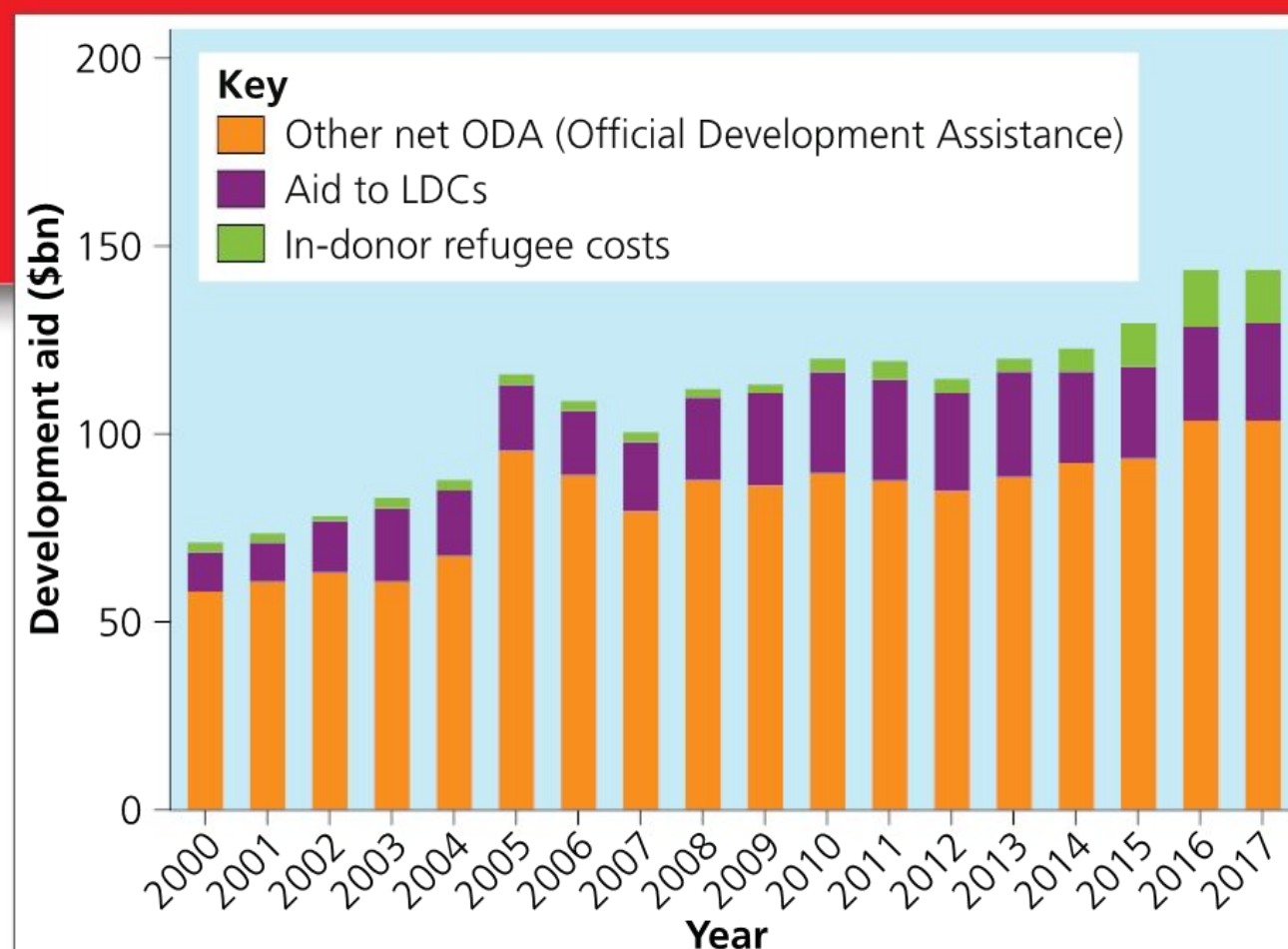


Figure 7.29 Development aid since 2000
Source: The Organisation for Economic Co-operation and Development

ACTIVITY: Different types of aid

ATL

- Communication skills: Collaborate with peers and experts using a variety of digital environments and media

In groups, choose one of the five types of aid:

- Bilateral aid
- Multilateral aid
- Voluntary aid
- Emergency aid
- Development aid

In your groups, carry out an online search for your chosen type of aid.

You may also want to watch this video:

https://youtu.be/oHiNFi_0hcl

Make notes under the following headings:

- Different names given to your type of aid
- Definition
- Main features
- Main forms of aid (goods or people or financial)
- Advantages
- Disadvantages

You could collaborate by creating a shared document on computers or a mind map on a large piece of paper where each member adds their notes under the heading of their choice.

Share your findings with the rest of the class, either in a presentation or by sharing your document or mind map.

Listen carefully to other groups as they present their findings or make notes from documents or displays made available in your classroom.

Make sure you ask clarification questions.

Concluding task

Return to your groups and answer the following questions:

- For each type of aid, does it benefit the receiving country, the donor country or both?
- How do local people benefit from each type of aid?
- Do all types of aid promote long-term development?
- Which types of aid seem to have more advantages? Why?
- Which types of aid seem to have more disadvantages? Why?
- Overall, which type of aid is the most effective in reducing inequalities?

Assessment opportunities

- This activity can be assessed using Criterion A: Knowing and understanding, Criterion C: Communicating and Criterion D: Thinking critically.

DISCUSS

Watch this video from the World Economic Forum:

<https://youtu.be/rh-DVQ3H7Q8>

Do you think aid really works?

Discuss

ACTIVITY: Aid case studies

■ ATL

- Information literacy skills: Collect and analyse data to identify solutions and make informed decisions; Identify primary and secondary sources
- Critical-thinking skills: Interpret data; Evaluate evidence and arguments

The class will be divided into four groups, each of which will **investigate** aid case studies in one of the following world regions:

- Africa
- South East Asia
- South and Central America
- Eastern Europe and the Middle East

As a group, **investigate** two or three countries within your region that received international aid. **Investigate** the issues that triggered the need for aid in the countries, the aims of the initiatives or programmes and evidence of success and failure. Write a short report that you will have to **present** to students from other groups. Include views from various stakeholders, maps at a range of scales to show areas receiving aid and any other useful factual information to support your points.

Reflection

In mixed regional groups, reflect on the following:

- What are the similarities and differences in the issues that trigger the need for aid in different parts of the world?
- Examine the differences in the various aid programmes across a range of case studies.
- Which types of aid programme are the most likely to impact on extreme poverty? Use evidence to support your views.

Reflect on the issues raised by this activity by writing a report of around 800 words in response to this question:

- Is international aid a suitable strategy for achieving the United Nations Sustainable Development Goals?

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion B: Investigating, Criterion C: Communicating and Criterion D: Thinking critically.

Should cultural exchanges be seen as a positive or negative product of globalization?

WHAT MAKES YOU SAY THAT?



■ **Figure 7.30** An advertising campaign for Mecca Cola

What does this picture tell us about the response to globalization? Is the company behind this cola brand global or local?

What makes you say that?

What is the message conveyed by the brand? Is the company embracing globalization or rejecting it?

WHAT IS THE DIFFERENCE BETWEEN CULTURAL DIFFUSION AND CULTURAL IMPERIALISM?

Cultural diffusion is the spreading of ideas, languages and cultural traits from one place to another. Culture can spread in many different ways throughout the vast array of networks and connections in our globalized world. Cultural traits are constantly diffused through migration flows, information flows and trade flows. In every major historical or contemporary migration flow, whether the inflow of economic migrants from Latin America to the USA or the 'sunset' migration of British pensioners to Spain and Mediterranean countries, migrants bring cultural traits and elements of language from their country of origin (see Figure 7.31). The opposite process also takes place when migrants return to their home country and bring back with them cultural traits, ideas or customs from their host country (see Figure 7.32).



■ **Figure 7.31** English–Spanish bilingual signs in a bakery in California



■ **Figure 7.32** A Spanish delicatessen in Wales, UK

The global flow of commodities and services has also contributed to cultural diffusion with many MNCs from developed countries exporting their products beyond their saturated domestic markets towards the developing world. Despite not being able to purchase the relatively more expensive imported goods, consumers in poorer nations are still exposed to the cultures and ideas of richer nations through marketing and advertising.

Many cultural traits, ideas and languages also spread with the creative and entertainment industries. The impacts of the music, web, film, streaming, fashion and sport media industries on other cultures are the most rapid and direct and often difficult to ascertain and identify.

The processes at play in globalization have helped to shape the new cultural landscapes of this century, which to some extent may be resisted by certain groups of people, countries or religions. According to the twentieth-century Austrian economist Joseph Schumpeter, capitalism can be associated with a process of creative destruction (see [Links to: Economics](#)). Similarly, despite the clear benefits of globalization, some people are questioning the potential destructive impacts of global interactions on individual cultures and identities.

In the following activities, you will think about the issues resulting from cultural diffusion. You will consider how different people around the world have different values, and take action to decide what aspects of globalization may have a positive, negative or neutral impact on cultures around the world.

ACTIVITY: Cultural diffusion

■ ATL

- Communication skills: Use a variety of speaking techniques to communicate with a variety of audiences

What is your goal?

Your goal is to portray through role play a real-life situation where cultural diffusion is taking place.

Processes and means by which cultural diffusion may happen include:

- Migration
- Mass tourism
- Global brands and consumer culture
- Media and creative industries
- Major sport events
- World cuisine
- Social media

How will you organize your project?

- 1 In groups of three or four, choose one type of cultural diffusion. Brainstorm what you already know about the type of diffusion you have chosen. You could draw ideas from your own experience.

Hint

Make sure you pick a type of diffusion not chosen by other groups so there is a good range of examples in the class.

- 2 Before imagining your role-play situation, you need to research how your diffusion type is helping to spread ideas and tastes from one culture into another culture. You could search for **cultural diffusion** followed by your chosen diffusion process. Focus on the interactions between people, communities, businesses and the media. Before writing your script, **identify** two or three ideas you would like your audience to understand while watching your role-play performance.
- 3 Practise your role play, making changes if necessary.
- 4 Perform your role play in front of the class. At the end of your performance, check that the class has understood the process of diffusion and the element of culture being diffused.

Evaluation

Were you successful in communicating your ideas to the audience?

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding and Criterion C: Communicating.

ACTIVITY: Reviewing the impact of cultural imperialism

■ ATL

- Critical-thinking skills: Gather and organize relevant information to formulate an argument



■ **Figure 7.33** A fast food restaurant in Dubai

- 1 Analyse the photo in Figure 7.33. Suggest reasons why McDonald's is linked with the promotion of American culture.

- 2 Watch this video: <https://vimeo.com/10275493> Describe the spatial and temporal pattern of the spread of McDonald's on a global scale.
- 3 Explain why American products and corporations have spread worldwide (as opposed to other products/corporations).
- 4 Discuss the positive and negative impacts of these products and corporations. How could they alter local cultures?
- 5 Suggest reasons why the American market is dominant.
- 6 Discuss the role other countries play in cultural globalization. How do other countries contribute to American culture?
- 7 As a class, agree on a definition of cultural imperialism.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.

DISCUSS

Do you think globalization is ending? Are there any signs of the world turning inwards?

Discuss

SOURCE D

'No one today is purely one thing. Labels like Indian, or woman, or Muslim, or American are not more than starting-points, which if followed into actual experience for only a moment are quickly left behind. Imperialism consolidated the mixture of cultures and identities on a global scale. But its worst and most paradoxical gift was to allow people to believe that they were only, mainly, exclusively, white, or Black, or Western, or Oriental. Yet just as human beings make their own history, they also make their cultures and ethnic identities. No one can deny the persisting continuities of long traditions, sustained habitations, national languages, and cultural geographies, but there seems no reason except fear and prejudice to keep insisting on their separation and distinctiveness, as if that was all human life was about. Survival in fact is about the connections between things; in Eliot's phrase, reality cannot be deprived of the "other echoes [that] inhabit the garden." It is more rewarding – and more difficult – to think concretely and sympathetically, contrapuntally, about others than only about "us." But this also means not trying to rule others, not trying to classify them or put them in hierarchies, above all, not constantly reiterating how "our" culture or country is number one (or not number one, for that matter).'

Extract from Culture and Imperialism by Edward W. Said

! Take action: Socratic seminar on the value of sociocultural exchanges

■ ATL

■ Communication skills: Paraphrase accurately and concisely; Negotiate ideas and knowledge with peers and teachers

The Socratic seminar principle

- ! A Socratic seminar is a question-driven discussion, named after the philosopher Socrates, who used questions to teach his students. In these discussions, students do not talk over one another; they listen to each other's comments respectfully; they do not attack anyone's opinions and they agree to disagree. The aim is to **develop** a deep understanding of the message from the author.
- ! As a class, **discuss** what the qualities for successful Socratic seminars are. Look at the rules below:
 - ◆ It is important that you talk to each other and not just to the teacher or the class's 'natural' leader.
 - ◆ You must use evidence from the text to support your ideas.
 - ◆ Ask questions if you do not understand a point made by a student or rephrase a point for clarification.
 - ◆ There is no need to raise your hand to speak but do not interrupt other people.
 - ◆ Everyone needs to have a chance to speak so make sure you do not take over the discussion.
 - ◆ Do not become argumentative with other students. All opinions are equally important.
- ! Come up with a class rule for running a Socratic seminar. You may find the 'dos and don'ts' format useful.

The task

- ! Before beginning the seminar, make notes from the text in Source D. After you have read the text, try to come up with some open-ended questions that can be used during the seminar.
- ! You may find the following questions useful:
 - ◆ Where does that idea come from in the text?
 - ◆ What does this word or sentence mean?
 - ◆ Could you rephrase this please?
 - ◆ Is this what you meant by ...?
 - ◆ What do you think the author is trying to say?

- ◆ What else could that mean?
- ◆ Who could be the audience for this extract?
- ◆ Who is the author of this text? What do we know about him? How does that shape our understanding of the text?

The seminar

- ! Organize yourselves into a circle with everyone facing each other. Begin the discussion with a student asking an open-ended question. You should spend between 15 to 30 minutes on the seminar.

Reflection and evaluation

- ! As a group, **discuss** the following:
 - ◆ What evidence did you see of people actively listening and shaping their understanding from other ideas?
 - ◆ How has your understanding been affected by the ideas **explored** in this seminar?
 - ◆ What parts of the discussion did you find most interesting? Which parts did you find the least interesting?
 - ◆ What would you do differently next time you are in a seminar?

Assessment opportunities

- ◆ This activity can be assessed using Criterion C: Communicating and Criterion D: Thinking critically.

Reflection

In this chapter, we have **described** the patterns of global interactions and trade and **explained** the role of international trade in creating inequalities in development. We have **analysed** the connections between our shrinking world and international flows of finance, labour and information. We have **investigated** the different types of aid. We have **outlined** the role of aid programmes in achieving development and reviewed several international aid strategies for achieving the United Nations Sustainable Development Goals. We have **taken action** to debate the positive and negative aspects of cultural exchanges.

Use this table to reflect on your own learning in this chapter.

Questions we asked	Answers we found	Any further questions now?			
Factual: What is the pattern of global trade? What are the main types of international flows? What is aid?					
Conceptual: What is globalization? What are the patterns in global interactions? How can global trade be fair for all?					
Debatable: Has global trade failed poor countries? Is aid an effective strategy for ending poverty? Should cultural exchanges be seen as a positive or negative product of globalization?					
Approaches to learning you used in this chapter:	Description – what new skills did you learn?	How well did you master the skills?			
		Novice	Learner	Practitioner	Expert
Communication skills					
Creative-thinking skills					
Critical-thinking skills					
Information literacy skills					
Organizational skills					
Transfer skills					
Learner profile disposition	Reflect on the importance of being knowledgeable for your learning in this chapter.				
Knowledgeable					

8

Do we have the right to
see the world?

- Global tourism can bring positive change for people and their cultures, but also disparities and inequality.

CONSIDER THESE
QUESTIONS:

Factual: How has tourism changed? What are the main tourist destinations? What are the main environmental impacts of tourism?

Conceptual: How can tourism be used to develop a country's economy?

Debatable: Does tourism always lead to the homogenization of cultures?

Now **share and compare** your thoughts and ideas with your partner, or with the whole class.

Thailand bay made famous by
The Beach closed indefinitely

The Guardian, 3 October 2018

Has tourism killed Venice? We visited during
the busiest month of the year to find out

The Telegraph, 17 August 2018

WHY BARCELONA LOCALS
REALLY HATE TOURISTS

The Independent, 9 August 2017

Bali considering new rules to clamp down
on tourists' offensive behaviour

news.com.au, 26 September 2018

■ Figure 8.1 Newspaper headlines

IN THIS CHAPTER, WE WILL ...

- Find out why tourism has changed.
- Explore the impacts of tourism in different places around the globe.
- Take action by looking at the impact of tourism on indigenous people.



■ **Figure 8.2** (a) A village in the Lake District, UK, (b) Oxford Street, London, UK, (c) tourists learning with an indigenous person, (d) an airport, (e) an overcrowded beach in Spain, (f) diving with turtles, (g) a private tropical beach with bar and hut, (h) a cruise ship

■ These Approaches to Learning (ATL) skills will be useful ...

- Collaboration skills
- Communication skills
- Creative-thinking skills
- Information literacy skills

● We will reflect on this learner profile attribute ...

- Open-minded – we will critically appreciate our own cultures and personal histories, as well as the values and traditions of others. We will seek and evaluate a range of points of view, and be willing to grow from the experience.

◆ Assessment opportunities in this chapter:

- ◆ **Criterion A:** Knowing and understanding
- ◆ **Criterion B:** Investigating
- ◆ **Criterion C:** Communicating
- ◆ **Criterion D:** Thinking critically

KEY WORDS

homogenize
tourism
sustainable

THINK–PAIR–SHARE

Look at the newspaper headlines in Figure 8.1 and the photos in Figure 8.2. What do they make you think about tourism? Share your ideas with a partner. Then share your ideas with the class. What issues might be important in our inquiry into tourism?

How has tourism changed?

Tourism takes many different forms, and has changed over the years. In the past, holidays, and tourism, were only enjoyed by wealthy people. During the late seventeenth and eighteenth centuries, it became fashionable for the rich to travel; young men from the upper classes, for example, would spend several months travelling around Europe on what was called the Grand Tour. Some authors have described their characters' journeys to see new areas, such as Henry James in *Daisy Miller*, while others found inspiration in their own travels: Mary Shelley's *Frankenstein* was a 'scary story' she made up for friends during a night staying at Lake Geneva in Switzerland. However, the ability to embark on a tour of this kind depended on having two things: independent wealth and plenty of time.

In the mid-twentieth century, certain countries, particularly in Europe, introduced paid holidays, which meant that working people could have time off work and still get paid. Many people would go on day trips to a local area, or somewhere in the same country, usually travelling by train, or by bus, as many did not have a vehicle of their own. Now, some definitions of tourism do not include day trips.

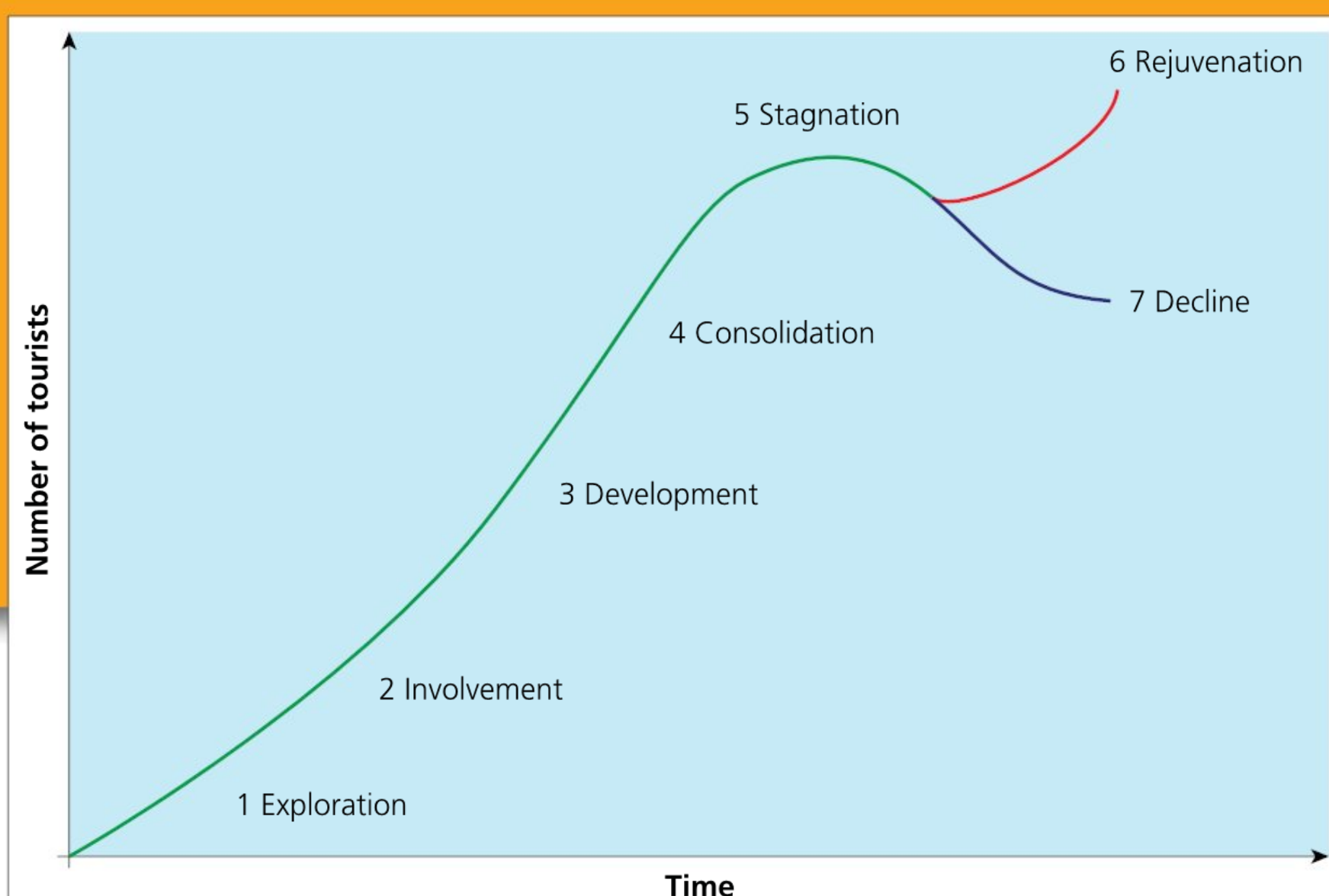
During the 1950s, the advent of the jet aeroplane meant that travel became quicker and more accessible, for those who could afford it. People started to travel in larger numbers to other countries to explore new places and cultures. This type of tourism was still out of the reach of many people. International mass tourism started with the cheaper package holiday, aided by the construction in some parts of the world of large hotels and airports, while specialized travel agents organized every part of the holiday. This was very popular during the 1970s, 1980s and 1990s in Europe. Consequently, some places became saturated with tourism, and people

started to want more from their holidays. This development is shown in the Butler model (Figure 8.3).

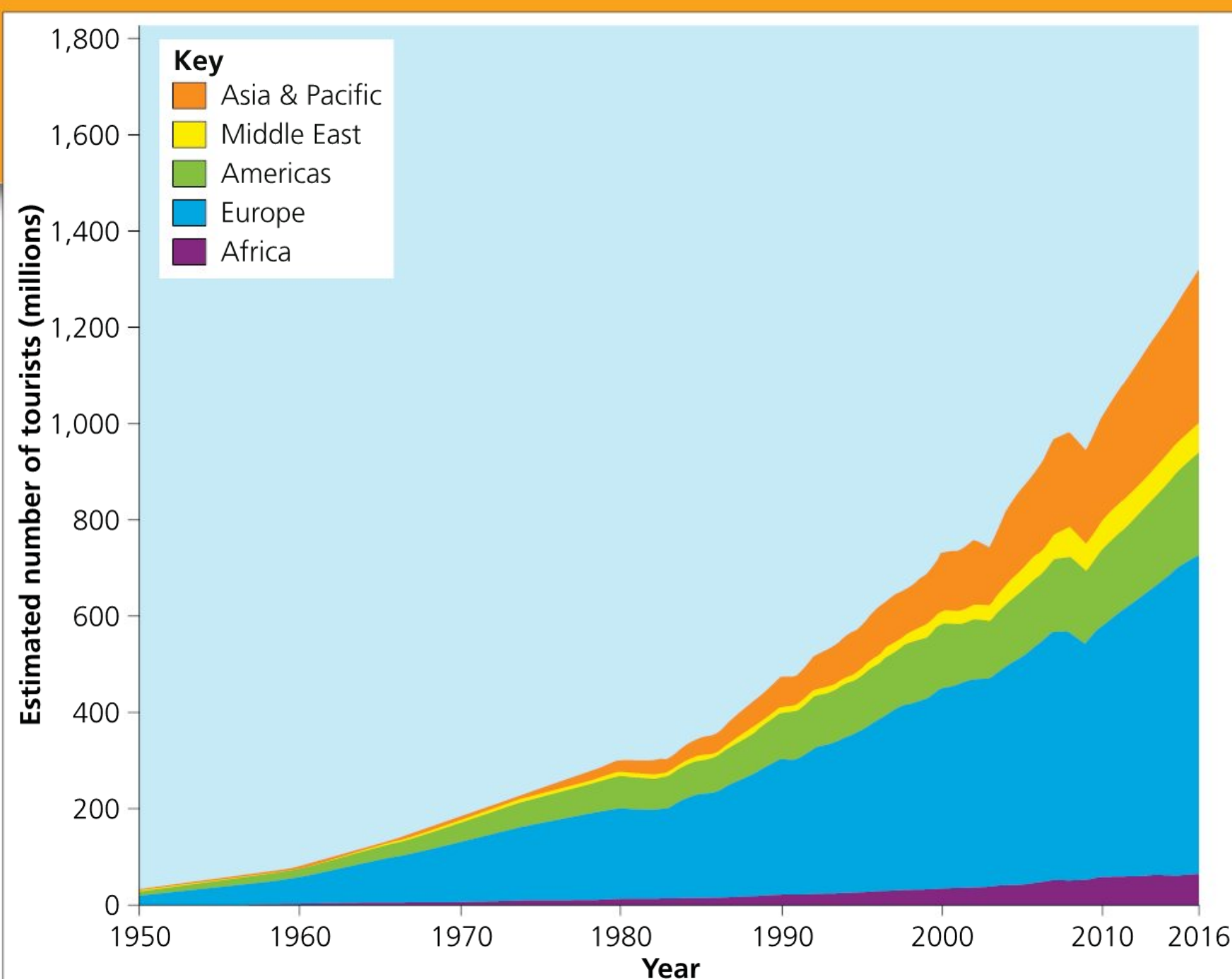
More recently, niche holidays, such as those based around **ecotourism** and adventure holidays, have taken off. Some areas that had become less popular have started to redevelop in order to attract these new types of tourist.

The reasons for the increase in tourism can be divided into several geographical factors:

- Socio-economic reasons. People have more free time at weekends and during paid holidays, have a disposable income (money left over after paying for essentials such as food and rent/mortgage) and are willing to travel further as it is quicker and cheaper than in the past. Technology has also facilitated the growth of tourism by providing more and varied opportunities for advertising, and access to better value for money as people book their holidays themselves over the internet.
- Environmental reasons. People are looking for new and different experiences on their holidays. Many still stay at a hotel near the attraction, such as a beach, but many people now want to travel to a greater variety of places and are concerned about the environment, so holidays that have an environmental element are increasingly popular.
- Political reasons. As global interactions between countries become more peaceable and friction-free, more people can obtain visas, or in many cases do not need visas for holidays; therefore, it is easy to travel for a short time.



■ **Figure 8.3** The Butler resort life-cycle model



■ **Figure 8.4** A graph showing tourism growth since the 1950s

ACTIVITY: How and why has tourism changed over time?

■ ATL

- Information literacy skills: Make connections between various sources of information

Figure 8.4 shows how tourism has grown since 1950 and where most tourists are from. On the following website play the timeline for how tourist arrival numbers have changed from 1995 to 2016: <https://ourworldindata.org/tourism#international-arrivals-by-country>

- 1 Compare** the total arrivals for each continent for 1995 and 2016.
 - **Europe:** For example, France was the only country to have over 60 million tourists arriving in the country in 1995. However, both France and Spain received this number of arrivals in 2016. By hovering over the individual countries on the map, you can see that the numbers in France have increased by over 20 million to 84 million and in Spain have increased from 32 million to 68 million.
 - **Africa:**

- **Asia:**
- **North America:**
- **South America:**
- **Oceania:**

- 2 Describe** how tourism has changed on a global scale. Give a general description of the global change, by focusing on the countries that had the highest number of arrivals in 1995 compared to the countries that had the highest numbers in 2016. Are there any countries that have experienced a rapid change? To **develop** your answers further, look for anomalies, for example by looking for countries that have experienced a decrease in numbers.
- 3 Suggest and explain** reasons for the changes in the global tourism numbers from 1995 to 2016.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding and Criterion D: Thinking critically.

What are the main tourist destinations?

ACTIVITY: Exploring the UNESCO World Heritage sites

■ ATL

- Information literacy skills: Understand and use technology systems

Use ArcGIS Online to help you **explore** the UNESCO (United Nations Educational, Scientific and Cultural Organization) World Heritage sites.

- 1 You will need to add a layer first with useful data showing UNESCO sites. Go to ArcGIS Online, open a new map and click on this link: <https://arcg.is/0DSy0v>. Once this has been added to your ArcGIS Online map, your map content should look like Figure 8.5.



■ **Figure 8.5** Map with the UNESCO World Heritage layer

- 2 The map does not show any useful data yet and shows only pins. To show useful data, you need to click on the *Change style* icon underneath the layer title (Figure 8.6).



■ **Figure 8.6** *Change style* option

- 3 The *Change style* option allows you to select the *Attribute* (the data) you want to show on your map. Click on the drop-down menu next to *1 Choose an attribute to show* and select your data. In the example, we are selecting *Category* (for different types of World Heritage Site) (Figure 8.7).



■ **Figure 8.7** Selecting the *Category* attribute

- 4 ArcGIS Online will automatically choose the map symbol for the data to visualize and in most cases it is appropriate (Figure 8.8).



■ **Figure 8.8** Map showing different types of World Heritage sites

- 5 To save your map, click on the **Save floppy disk icon** and then select **Save as**. You need to give your map a *tag* so it can be saved. Click on the blue **Save as** button.
- 6 **Describe** the pattern of World Heritage Sites using the TEA technique (see page 12 for how to describe patterns on maps). Use the '+' or '-' buttons to zoom in or out on different regions.

- 7 In pairs, **discuss** the following questions:

- How can the distribution of different types of heritage sites be **explained**?
- How can you **explain** some types of distributions? Click on the coloured dots for help. Some major sites have dots with further information (see Figure 8.9).



■ **Figure 8.9** Pop-up window with additional information

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding.

WHAT ARE THE MAIN TYPES OF TOURISM?

Find out what **niche tourist destination** means. As we have seen, tourism has increased over time and in many areas around the globe. During the 1980s, **mass tourism** was very popular. Package holidays were popular with families; you paid for the hotel and flight together, which was cheaper than paying for each element of the holiday separately. Many people were able to go on holiday, both in their own country and internationally.

Niche tourism has increased due to demand for a new holiday experience. Younger people in higher-income countries who have no children tend to want a more exciting holiday than the ones they had as children themselves; they tend to be more environmentally aware and have more disposable income. They want adventure holidays and want to travel to places that they have not been to before. Skiing used to be the adventure holiday for many in the 1980s, but now the adventurous tourist is more likely to be found extreme mountain climbing, diving, mountain biking, on desert island survival holidays, or even travelling to the North Pole. Ecotourism is becoming popular due to the increasing awareness of the environmental pressure that traditional mass tourism had on tourist areas.

Niche holidays are not just for the rich, young and active. 'Silver holiday destinations' cater for the increasing number of retired people who have both time and money. These include cruises or other packaged trips marketed to the over 50s.



Figure 8.10 (a) A family beach holiday, (b) ecotourism, (c) an Antarctica holiday

DISCUSS

What might prevent people from going on holiday, or restrict the kind of holiday they can take? Think in terms of SEEP (social, economic, environmental, and political factors – see Figure 1.44 on page 26). For example, are there any high-income countries (HICs) that might have more people travelling internally rather than taking international holidays?

ACTIVITY: Who's a tourist?

■ ATL

- Communication skills: Make effective summary notes for studying

Copy Table 8.1 and complete the description and explanation of how each type of tourism has developed over time. What type of people go on each of these types of holiday?

Research to **find** other types of tourism that have developed recently.

Share your ideas with a partner and then share with the class.

Hint

Think in terms of socio-economic factors that apply to the tourist.

Type	Scale/type	Development and who is likely to go on this type of holiday
Day trip	Local	Development: This involves people travelling to a local area for a day for leisure time. In the past, this was the main type of tourism, as many people did not have paid holidays and did not have transport of their own or access to affordable travel. Today, many people travel during the weekend for day trips, but they tend to travel on their own, using their own form of transport (usually their own car, or a hired car), or a train. Who: Many people go on day trips, some to get out of urban areas, others to visit a city for shopping/visiting museums, etc.
Overnight: urban	National	Development: Who:
Overnight: rural	National	Development: Who:
Overnight	Mass tourism: international	Development: Who:
Overnight	Niche tourism: international/ecotourism	Development: Who:
Overnight	Niche tourism: international/adventure	Development: Who:
Overnight	Niche tourism: international/silver tourism	Development: Who:

■ **Table 8.1** The development of tourism over time

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding.

ACTIVITY: Advertising a holiday

■ ATL

- Communication skills: Write for different purposes
- Creative-thinking skills: Apply existing knowledge to generate new ideas, products or processes

Choose one holiday type:

- Urban destination for people who like culture
- Rural destination for people who like to stay in their own country
- Adventure holiday for a couple in their 20s
- Ecotourist holiday for a family with teenagers
- Holiday for a family that likes to have everything organized for the children while the parents relax
- Holiday for a retired couple that like to see many different places

Design a holiday advertisement for the target market.

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion C: Communicating.

▼ Links to: Language acquisition

In your MYP Languages acquisition classes you may have studied tourism in countries that speak the language you are learning. Can you produce your advertisement – or parts of it – in the language of the country to be visited?

What are the main environmental impacts of tourism?

Tourism has had both negative and positive impacts on the environment. At an international, global scale, tourism is generally seen as negative due to the increase in air travel and cruises. Carbon **emissions** have increased as air and sea travel has increased. At a national and local scale, the impacts can be negative when building hotels, using water for swimming pools in arid (dry) areas and watering golf courses in areas where there is very little rain. However, some argue that tourism can bring environmental benefits: visits can be educational, teaching visitors about the importance of the natural habitats, tourism can bring investment in more sustainable energy methods and it can lead to clean beaches and other local environments as governments legislate in support of the tourism industry.

Transnational corporations (TNCs) have become very important in the development of tourism in low-income countries (LICs), where many tourist destinations are located. Tourism is seen as a way for the country to develop its economy, and many LICs have moved from a primary and/or manufacturing-based economy to a tertiary economy. TNCs invest in tourist areas by developing infrastructure, such as transport links, airports, good quality roads, better water and electrical supplies, and improved sanitation. There may even be investment in developing schools and hospitals for the area. Once this **economic multiplier effect** occurs, the country can invest in other development projects in other parts of the country. There are, however, criticisms of countries relying on TNCs to develop their tourism industry. Some suggest it can be counter-productive, since people travel to such areas for their natural beauty or history: known as **primary tourism resources**. When an area develops tourism, **secondary tourism resources**, such as hotels, airports and new infrastructure, can impact on the attractiveness of the destination.

ACTIVITY: To have or not to have tourists

■ ATL

- Communication skills: Structure information in summaries, essays and reports
- Information literacy skills: Access information to be informed and inform others

Tourism brings with it money, but also problems. Many governments are now trying to reverse the trend, and rather than encouraging tourists to come and spend their money have started to discourage tourism in the hope of solving the environmental issues that the tourists have brought.

You are going to **investigate** a location where tourism has caused environmental issues. Choose one of the following, or one of your own choice that your teacher has agreed to:

- **Maya Bay, Thailand, as used in the film *The Beach***
- **Venice, Italy**

Carry out research into the environmental issue that is affecting the region you are looking at. You could use:

- **Maya Bay:** www.theguardian.com/world/2018/oct/03/thailand-bay-made-famous-by-the-beach-closed-indefinitely
- **Venice:** www.independent.co.uk/travel/news-and-advice/venice-may-day-tourism-separate-tourists-locals-segregation-weekend-a8323956.html

Write a report into what the region should do to try and reduce the environmental effect but still maintain an income.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding, Criterion B: Investigating, Criterion C: Communicating and Criterion D: Thinking critically.

How can tourism be used to develop a country's economy?

Tourism is an important part of the global economy. Many countries rely on tourism for a large proportion of their **Gross National Income (GNI)**

Many factors affect why people choose to visit a tourist destination. The weather is an important factor, but natural disasters and incidents of terrorism also have an impact on tourism as well as other aspects of a country's economy. For this reason, it is important that tourism is not the only source of income for a country, and that the country is not economically dependent on it. For many places, however, tourism is the only source of income and can therefore have considerable impact on development.

Many countries want to attract tourism because it boosts the economy quickly. If a country has good primary tourist resources, it is only the secondary tourist resources that need to be developed to attract more people to the area. Often, countries take out loans or allow foreign direct investment (FDI) to develop the infrastructure and therefore attract businesses. This, in turn, provides jobs for local people, which means the government can collect taxes and then invest in other development programmes, such as health or education. Many people therefore have some link to the tourist trade, whether it is direct (they work for the tourist industry), indirect or through informal work. Whatever form this link takes, it means they have an income.

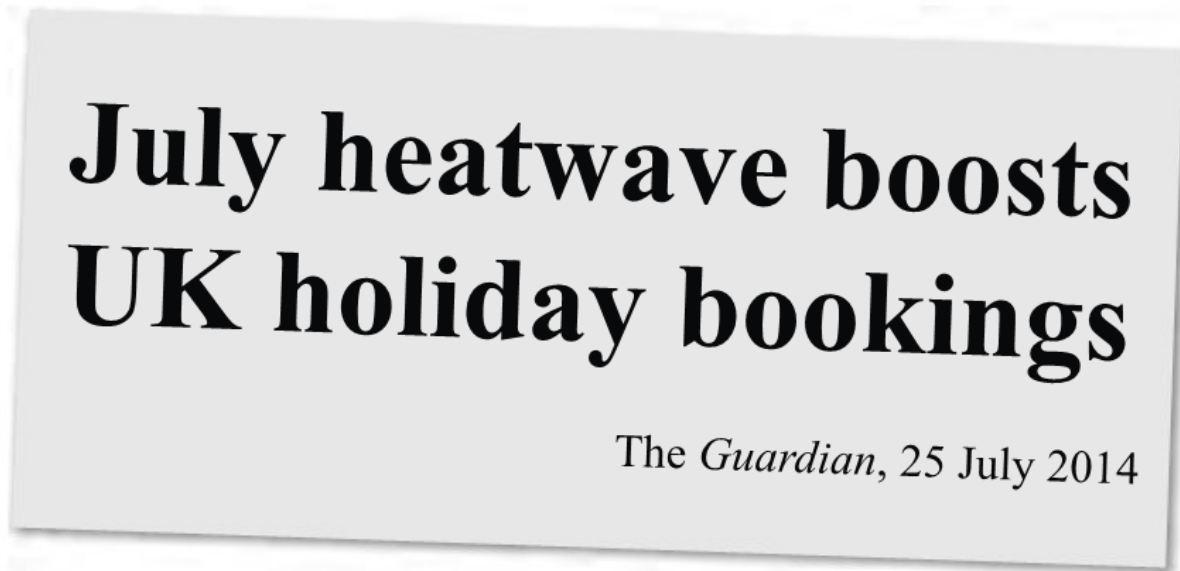
Of course, the government has to repay any loans (with interest) and FDI means that some of the money made by tourism is exported back to the TNC's home country; this movement of profits out of the country is called leakage.

Many people believe that once an area begins to develop then money will start to trickle into other areas, which should allow them to develop economically. However, in many places **tourism enclaves** have been developed. This means that tourists only stay in a small area; other parts of the country or region do not benefit from the tourist trade except indirectly. Cruise ports are an example of this as people get off the cruise ship to visit the port but never see any other part of the region. While this may be good news for the enclave that tourists visit, as it can bring much money into the local economy via shopping, bars and restaurants, it means that the positive impact is geographically limited.

ACTIVITY: Tourism drivers

- ATL
- Collaboration skills: Build consensus

In pairs, research headlines about the factors that cause an increase or decrease in tourism (see the headlines in Figure 8.11 below and Figure 8.1 on page 180 for ideas). Make notes on your findings and then copy and complete Table 8.2 to **classify** them into positive factors that increase economic activity and negative factors that can decrease economic activity because of tourism.



■ **Figure 8.11** A newspaper headline

Factors	Negative	Positive
Social		
Economic		
Environmental		July heatwave boosts UK holiday bookings: The Guardian (25/7/2014)
Political		

■ **Table 8.2** Factors that affect tourism

- ◆ Assessment opportunities
- ◆ This activity can be assessed using Criterion A: Knowing and understanding.

Furthermore, many local people working in the tourist trade tend to be low wage earners, but tourism drives up prices for food, transport and housing. Therefore, the local people, who should benefit from the tourist trade, suffer instead. In many areas – such as ski-resorts – tourism is seasonal, which means that for part of the year, many locals are out of a job and have to find work elsewhere.

Does tourism always lead to the homogenization of cultures?

SEE-THINK-WONDER

Look at the photos in Figure 8.12. What do they make you think and wonder about tourism? Share your ideas with your group or class.

While tourism is for many regions a vital source of income, it also brings socio-cultural impacts. The socio-culture of a country includes the everyday lives of the people who live there as well as the traditions, customs and beliefs of the country. Many areas affected by mass tourism attract people from different places around the globe by offering something that is different from what they usually see or experience. However, many people still want a little piece of home when they are on holiday. This could be a global cafe, restaurants that sell cuisine from their home country or workers who speak their language. What does this mean for the people who live and work in these tourist areas?

Significant socio-cultural impacts come about when tourists bring with them different values that can threaten the local/indigenous culture. For example, in the past, modern hotels often replaced traditional-style buildings, which many see as destruction of the primary tourist resource. Younger people working in tourist areas can see a Western lifestyle as attractive and want to copy it, which can cause tension in families and affect the social structure. Culture clashes occur when people from different backgrounds, socio-economic groups, ethnicities, religions and values meet and have not had time to understand each other's differences. Initially, local people might see the benefits of tourism, but over time and with changes to the landscape and the culture, this might lead to unrest between groups. Crime rates can increase due to an increase in alcohol and drug intake; pickpocketing can become an issue in areas where there are lots of tourists. In many parts of the world, tourism brings exploitation such as child labour or sex trafficking. For many who live in poverty, the lure of consumer items that they could never before have obtained means some children or young adults are lured into sex work or exploitation in the tourism sector and in some places where this occurs, regulations, laws and policing are not as stringent as they might be.

Over time, the interaction of tourism with local cultures means that cultures become less distinct, and there is homogenization – less and less difference between the tourist and the local person. Clothing, food, drink and attitudes become more similar. Some people might see this as a positive thing: why should a young person not be allowed to wear specific clothing, or eat certain foods?



Figure 8.12 (a) Dani tribespeople, West Papua, Indonesia, (b) holidaymakers in Magaluf, Spain, (c) culture clash with tourists: sign in a Spanish church

Others see it as the erosion of traditions. Language can also be affected. In many places, people speak several languages so as to interact with tourists.

In certain tourist areas, there has been criticism of **zooification**, where tourists are brought to look at the indigenous people. Many have argued that this then means the local people exaggerate their traditional culture or conform to what the tourists want or expect. However, it is also argued that by making money from their culture, the people are able to access a better quality of life due to increased spending on health, sanitation and education.

Tourism can be a force for bringing communities together, provided they keep their cultural values and recognize the importance of learning from different cultures. People become more open-minded when they interact with those from other cultures, and a more tolerant society can develop. Sustainable tourism should look after the environment, protect the economy and culture of the area, and develop understanding between people.

EXTENSION

Sustainable tourism aims to ensure that tourism does not destroy the environment, economy or culture of the host country. Ecotourism is a form of sustainable tourism, which has a focus on the environment. Carry out research into how some countries have developed strategies to make sure that tourism does not destroy their economy, environment and culture. The website <https://sustainabletourism.net/> is a good starting point. Click on the case studies section and then destinations to **find** out more about how tourism can be sustainable on each continent. Make an infographic on sustainable tourism for one continent.

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion D: Thinking critically.

ACTIVITY: Evaluating the impacts of tourism

■ ATL

- Communication skills: Organize and depict information logically; Structure information in summaries, essays and reports

You are going to carry out research for an academic newspaper about the impacts of tourism on an indigenous population.

Answer the following questions in your report:

- Where does this population live? (Provide a map of the country and the area.)
- What is traditional life like for the indigenous population? Think in terms of clothing, housing, food, beliefs and social structure. These are known as cultural traits (for more information about cultural traits, see *MYP Individuals & Societies by Concept 3*).
- When did tourism start to develop in the area?
- What are the primary and secondary tourism resources in the area?
- What are the main interactions between tourists and the indigenous population?
- What are the main cultural and environmental impacts on the indigenous population and the surrounding area?
- Who benefits more from this interaction – tourists or the indigenous population – and why?

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding, Criterion B: Investigating, Criterion C: Communicating and Criterion D: Thinking critically.

! Take action: Stand up for their rights

■ ATL

■ Collaboration skills: Practise empathy

- ! Many indigenous populations around the globe are losing land and their culture due to global interactions such as tourism. Survival International (www.survivalinternational.org) is an organization that promotes protection for indigenous people's rights.
- ! The United Nations Sustainable Development Goals (SDGs) can be used to help protect the rights of indigenous peoples. Use this website to help you understand more about how the goals can be used to do this: www.un.org/sustainabledevelopment/blog/2016/05/how-can-the-sdgs-best-help-indigenous-peoples/
- ! Why not set up a club to promote the rights of indigenous peoples and the UN's SDGs?
- ! The UN's International Day of the World's Indigenous Peoples is on 9 August. Your class or group could raise awareness of the issues that many indigenous groups face. Visit the United Nations website to source more information: www.un.org/en/events/indigenousday/
- ! The Visible Thinking Routine Making It Fair can be used to help find actions to investigate further.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion C: Communicating and Criterion D: Investigating.

MAKING IT FAIR: NOW AND LATER

A routine for finding actions:

- 1 **Frame the task.** Present the issue of indigenous people's rights. Think about issues that have affected their rights.
- 2 **Brainstorm ideas** for how they can protect their rights.
- 3 **Sort the list into actions** for making it fair for indigenous peoples in the past, now and for the future.
- 4 **Evaluate.** Pick one idea from the list that you think has the most merit/importance and expand on it. Is there any action you, the school or the government could do to help protect indigenous rights?

Reflection

In this chapter, we have **described** and **explained** how tourism has increased over the years. We have **evaluated** the impacts of tourism by looking at how it can bring benefits for the host country, or region, such as providing jobs, investment in improving the infrastructure, and opportunities to meet people from different cultures, but also how it can bring negative impacts such as crime, economic leakage, exploitation and an increase in environmental damage. We have **taken action** by understanding the impacts that tourism can have on indigenous cultures and to understand how we need to make sure that we plan, so all can see the wonders of the world now and in the future.

Use this table to reflect on your own learning in this chapter.					
Questions we asked	Answers we found	Any further questions now?			
Factual: How has tourism changed? What are the main tourist destinations? What are the main environmental impacts of tourism?					
Conceptual: How can tourism be used to develop a country's economy?					
Debatable: Does tourism always lead to the homogenization of cultures?					
Approaches to learning you used in this chapter:	Description – what new skills did you learn?	How well did you master the skills?			
		Novice	Learner	Practitioner	Expert
Collaboration skills					
Communication skills					
Creative-thinking skills					
Information literacy skills					
Learner profile disposition	Reflect on the importance of being open-minded for your learning in this chapter.				
Open-minded					

9

What are the consequences of our inaction in response to climate change?



- Both the **causes and consequences** of climate change are **global in scope**; we must ensure that we can manage the changes **sustainably**.

CONSIDER THESE QUESTIONS:

Factual: What are the main layers of the Earth's atmosphere? What is the energy budget? What are greenhouse gases and why are they important to the world's climate?

Conceptual: What patterns and trends give evidence for global climate change? What natural causes are there for climate change? What are the main human causes of climate change? What are the consequences of climate change?

Debatable: Can we manage global climate change consequences?

Now **share and compare** your thoughts and ideas with your partner, or with the whole class.

IN THIS CHAPTER, WE WILL ...

- Find out** the causes and consequences of global climate change.
- Explore** examples of how different parts of the world respond to the consequences of climate change.
- Take action** by finding out ways to promote sustainable responses to global climate change.

These Approaches to Learning (ATL) skills will be useful ...

- Collaboration skills
- Communication skills
- Creative-thinking skills
- Critical-thinking skills
- Information literacy skills

Assessment opportunities in this chapter:

- ◆ **Criterion A:** Knowing and understanding
- ◆ **Criterion B:** Investigating
- ◆ **Criterion C:** Communicating
- ◆ **Criterion D:** Thinking critically



■ **Figure 9.1** The consequences of climate change: **(a)** a forest fire, **(b)** Al Gore in *An Inconvenient Truth*, **(c)** a polar bear looking for food

- We will reflect on this learner profile attribute ...
- Caring – we will think about why we should care about the impact of climate change on others.

KEY WORDS

absorption
emission

equilibrium
reflection

ACTIVITY: 3–2–1 BRIDGE

Causes of climate change

Individually, write down:

- 3 thoughts
- 2 questions
- 1 analogy

... about the causes of global climate change. What do you already know about it? What questions do you have? What does this make you think of, or remind you of?

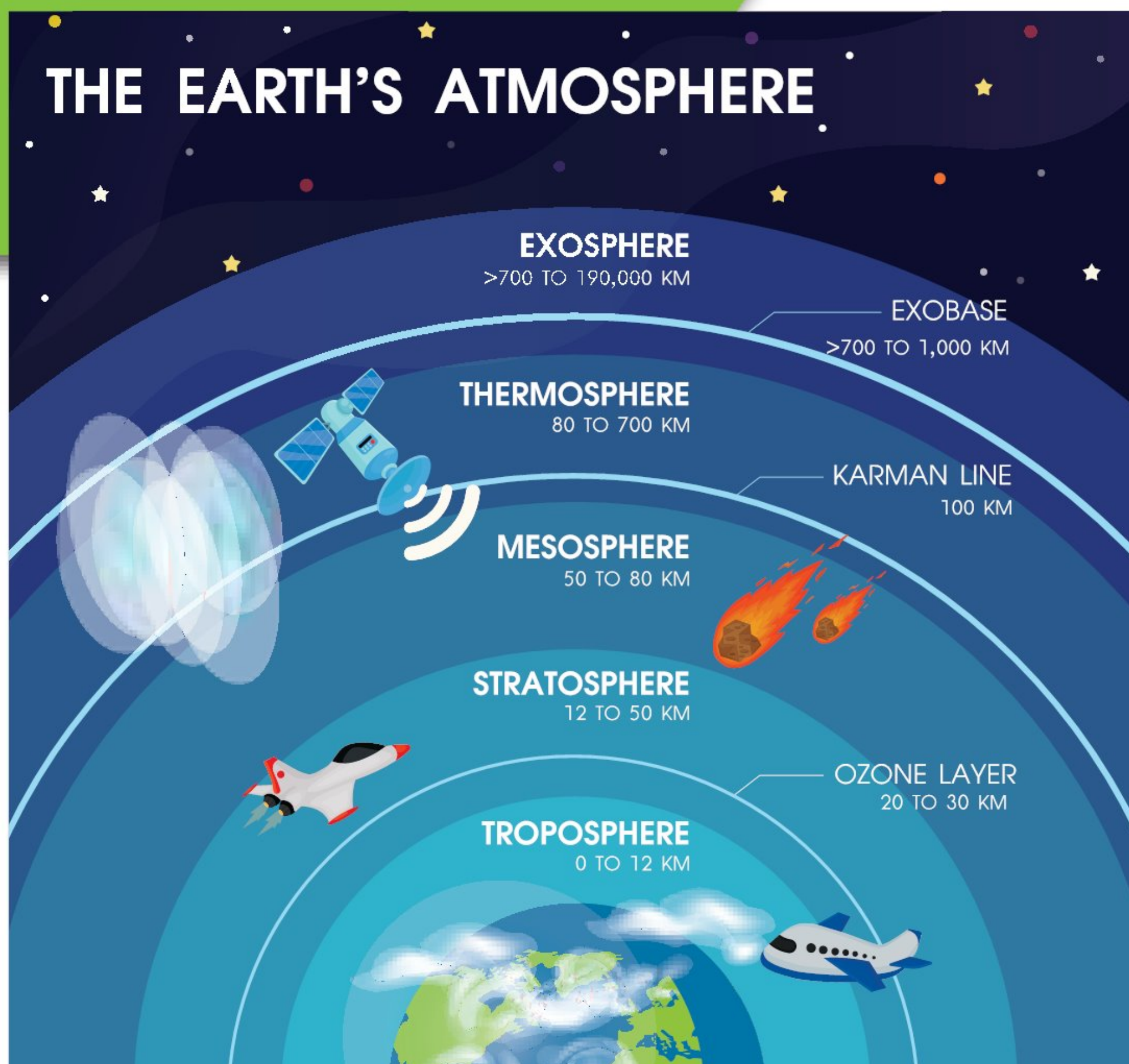
Once you have done this, share your ideas with the class. Do you have the same or different ideas from each other? You will repeat this activity at the end of the section to see how your understanding of the causes has changed.

SEE–THINK–WONDER

Look at the photos about climate change in Figure 9.1. What do you see? What do you think about what you see? What does it make you wonder?

You can't have missed the reports in the media about climate change, and the argument that the changes we are observing are too great and too rapid to be attributed to natural causes alone. In this chapter, we will be exploring the characteristics of climate change and the causes that are due to natural processes and human activities. We will investigate the patterns and trends that have led scientists to conclude that climate change is happening because of the activities of humans. We will also focus on some of the consequences of the rapid increase in the global temperature that are already happening, and others that could still happen – and how we can respond to this increase.

What are the main layers of the Earth's atmosphere? What is the energy budget?



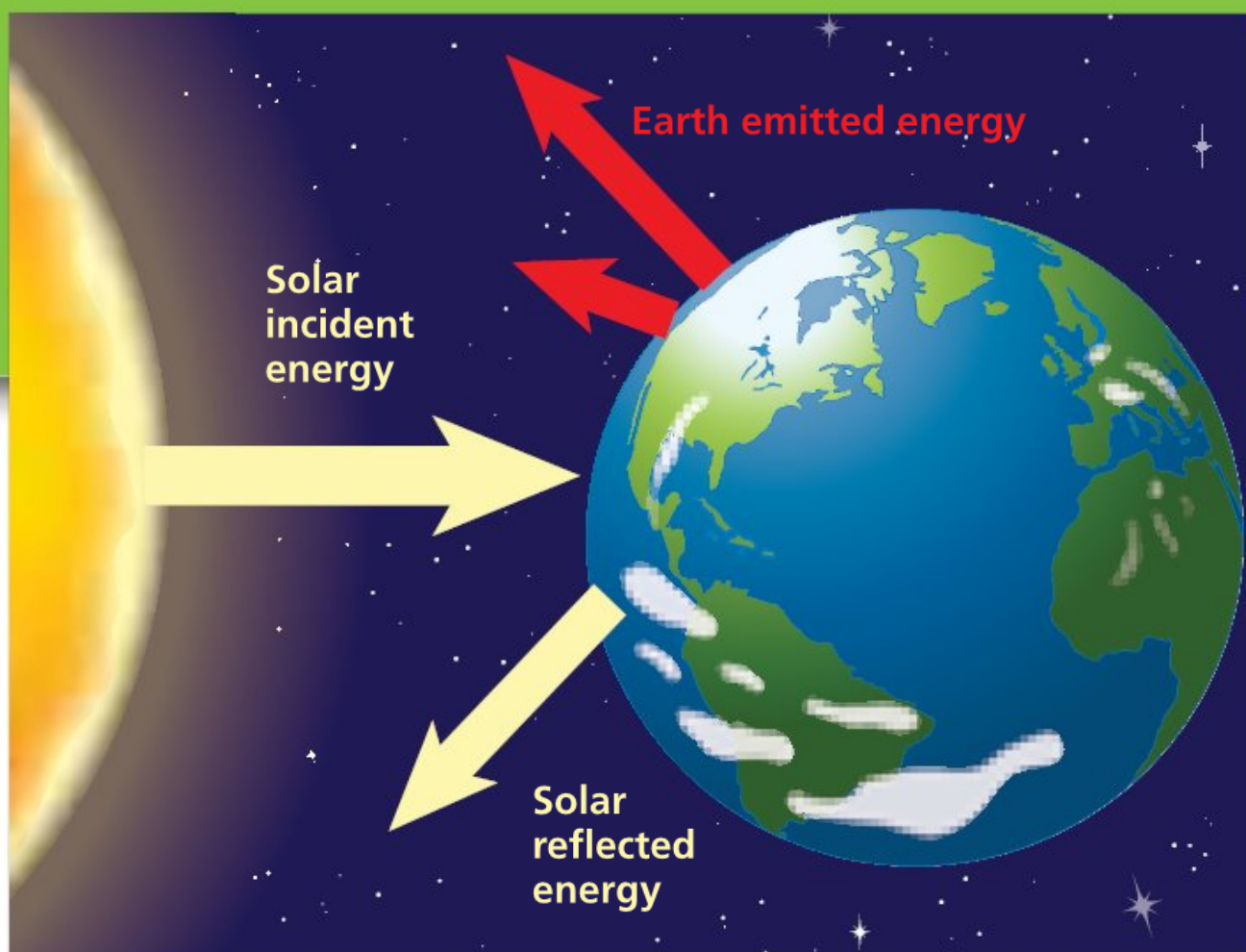
■ **Figure 9.2** The Earth's atmosphere

To understand how the climate is changing we need to understand the nature of the **atmosphere** and how the atmosphere interacts with the Earth's mass so that the Earth's temperature is regulated. Figure 9.2 shows the layers in the Earth's atmosphere. As the distance from the Earth increases, the density of the atmosphere decreases (the air thins). The lowest and most dense part of the atmosphere is known as the **troposphere**. Our weather occurs in the lowest layer of the troposphere, while the upper regions of the troposphere, known as the **stratosphere** is where aeroplanes fly. The ozone layer is a layer within the stratosphere that is relatively rich in a form of oxygen molecule called **ozone** O_3 ; this thin layer is important as it filters out some of the Sun's more energetic, shortwave **ultraviolet radiation**. The troposphere and stratosphere together extend to about 50 km above the Earth's surface.

The temperature across the troposphere and stratosphere steadily decreases from an average of 35°C at the Earth's surface to around -75°C at the outer reaches of the stratosphere, where it becomes known as the **mesosphere**. This is the region where most meteors burn up, and beyond this are the regions where cosmic rays and particles interact with gas molecules to form **aurorae**.

EXTENSION

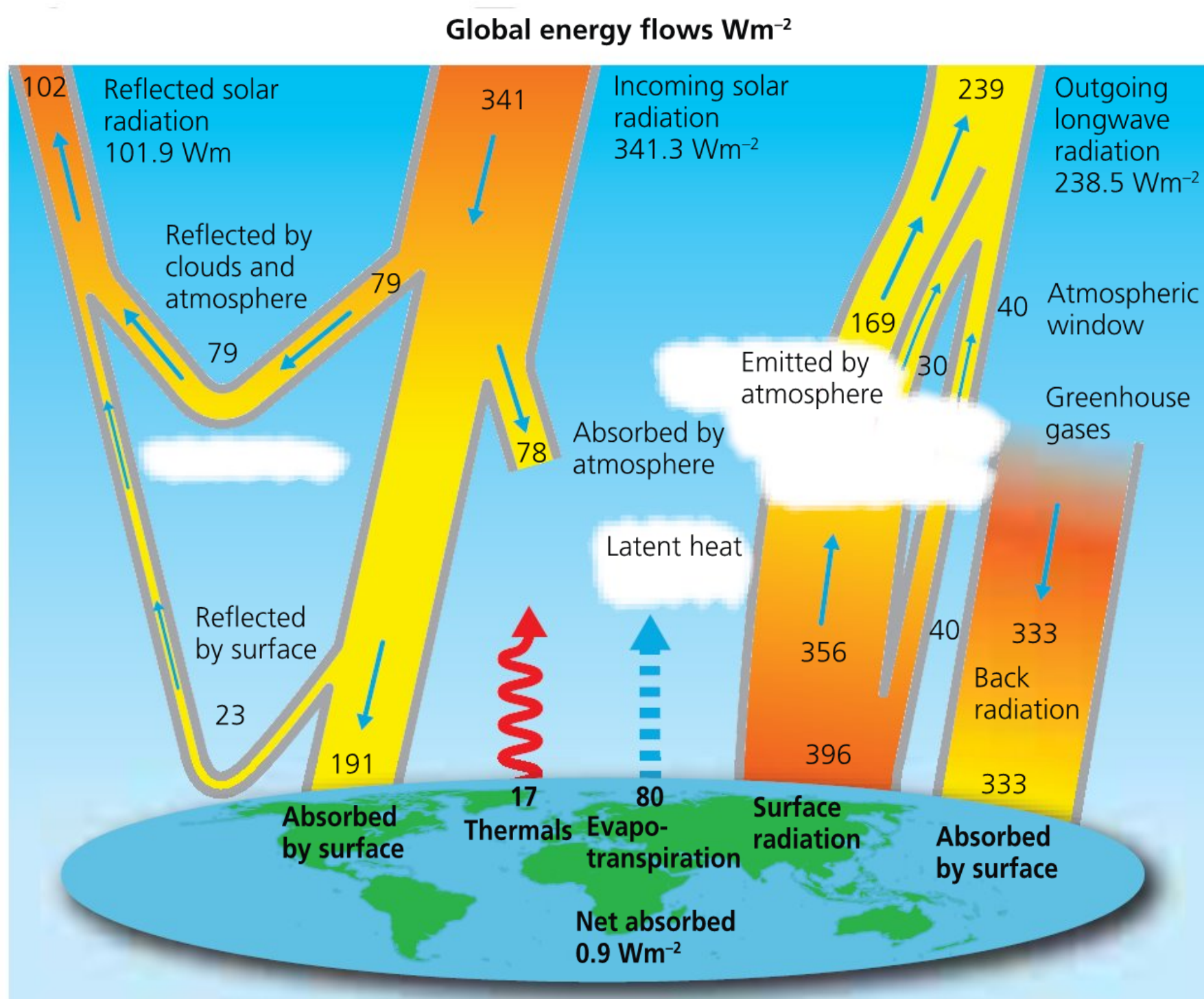
Carry out further research into what happens in the other **atmosphere layers**: **mesosphere**, **thermosphere** and **exosphere**. What happens to the temperature as you go further up into the atmosphere?



■ **Figure 9.3** A simple version of the Earth's energy budget

Most of the Earth's energy comes from the Sun. The atmospheric temperature is maintained by solar energy. If the Earth absorbed all the **incident energy**, we would be constantly heating up. However, the Earth's average temperature has not changed much since the last Ice Age, just under 12,000 years ago. For the Earth's temperature to be regulated, and equilibrium maintained, some of the Sun's incident energy must be lost into space. This balance of incident and lost energy is known as the Earth's **energy budget**

Figure 9.4 shows the Earth's energy budget. The amounts of energy are measured in watts per metre-squared (Wm^{-2}). Notice that there are two main processes by which energy is lost from the Earth and from the atmosphere: by **reflection**, or by **absorption** and **emission**.



■ **Figure 9.4** The Earth's energy budget

ACTIVITY: The Earth's energy budget

■ ATL

■ Critical-thinking skills:
Interpret data

Research the terms: **wavelength**, **shortwave radiation**, **longwave radiation**, **latent heat**, **conduction**.

State the meaning of each term and **explain** how it applies to the Earth's atmosphere.

Describe the diagram in Figure 9.4.

Hint

Use the figures that are given in the diagram when describing what it shows.

Think in terms of a system: inputs, transfers/flows/processes and outputs.

Analyse the diagram to **determine** the percentage of the Sun's energy that is lost:

- to space by reflection
- through absorption and emission.

Describe how the energy lost to space through these two different processes might differ.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding and Criterion D: Thinking critically.

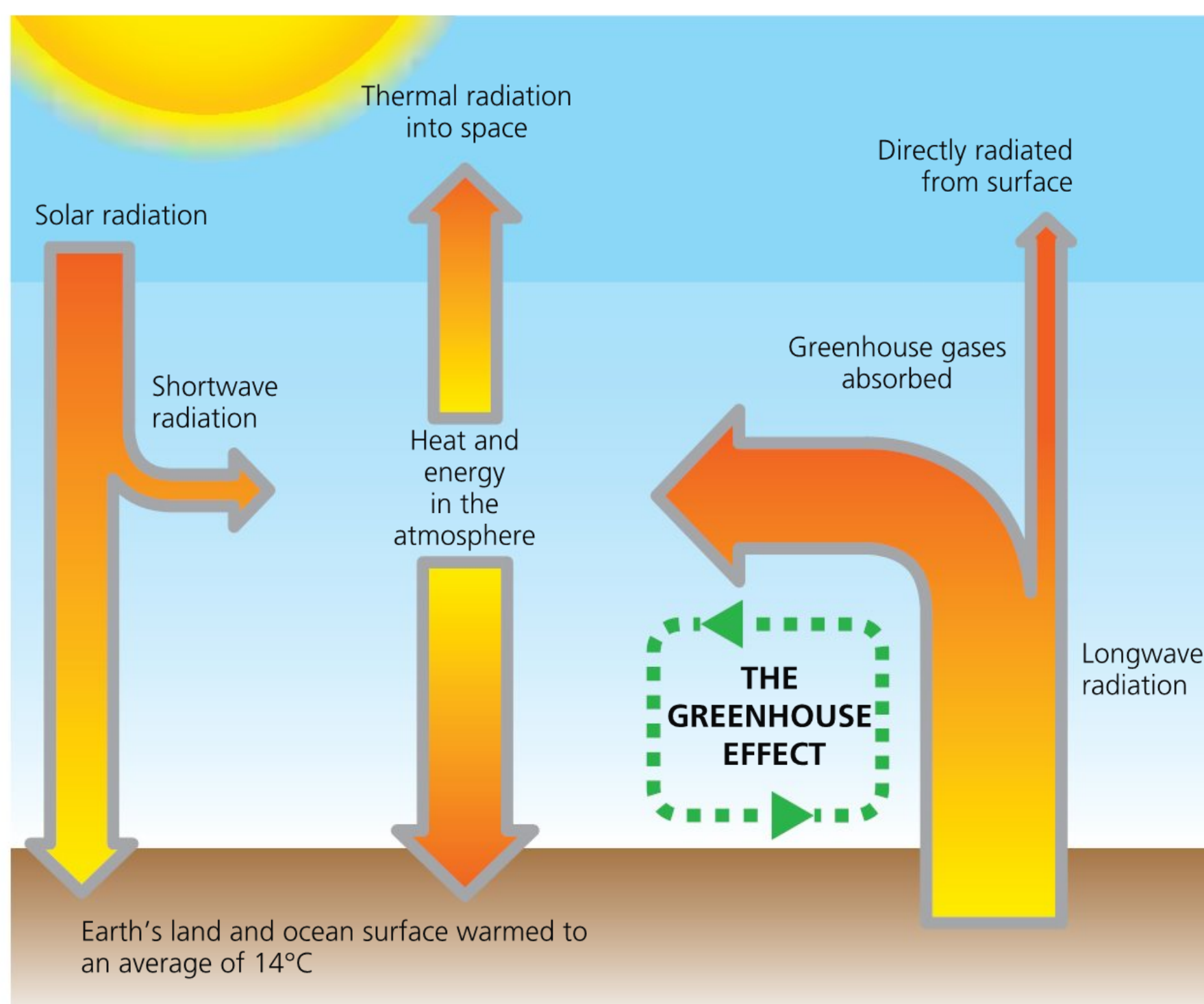
What are greenhouse gases and why are they important to the world's climate?

As shown in Figure 9.4, the Earth naturally regulates its temperature by reflecting longwave radiation out and by having gases in the atmosphere that can absorb the shortwave radiation. The layer between the troposphere and the stratosphere known as the ozone layer is particularly important in this respect since it absorbs, and so shields the Earth from, certain kinds of ultraviolet light that have shorter wavelengths. Shorter wavelength radiation tends to carry most energy and can damage biological material – in the extreme, very short wavelength radiation such as x-rays and gamma rays can cause damage to DNA and so lead to cancerous mutations, but even ultraviolet radiation in large enough doses can cause 'burning' – that is, cellular damage.

THINK-PAIR-SHARE

What are your first thoughts when you hear the term 'greenhouse effect'?

Share your ideas with a partner. Then share with the rest of the class.



■ **Figure 9.5** The Earth's short- and longwave radiation transfer

Greenhouse gases are gases that absorb longer wavelength, **infra-red radiation** from the Sun and reflect some back down to the Earth. They are so called because this effect was thought to work in the same way as glass in a greenhouse, which causes solar radiation to be 'trapped' and so warms the air inside the greenhouse. In fact, the atmospheric process of greenhouse warming is far more complex than this. There are many greenhouse gases but the most important ones are carbon dioxide CO_2 , methane CH_4 , water vapour H_2O and ozone O_3 . It is important to realize that without these gases, the Earth's atmosphere would have a very different equilibrium temperature: it would be a whole lot colder on the planet and life would be far less sustainable. This action is known as the natural **greenhouse effect**; the gases occur naturally and the Earth needs them to trap the heat to maintain life. Figure 9.5 shows this process, where most of the shortwave solar radiation is absorbed or reflected into space, and the remainder is absorbed by the Earth. This absorbed shortwave radiation transfers energy to the Earth, raising its temperature, and this in turn causes the Earth to re-emit some radiation. However, the **back radiation** is emitted at a longer wavelength than before, such that it is more likely to be absorbed by greenhouse gases in the atmosphere, again raising *their* temperature and subsequently being re-emitted once more.

▼ Links to: Sciences, Physics

These processes of absorption and re-emission of energy are known as 'black body radiation' because, in physics, the perfect absorber and emitter of radiation would be a black sphere. Of course, the Earth is not a black sphere, and so some of the Sun's radiation is reflected or its energy kept – luckily for us. (You can **find** out more about these effects of radiation in *MYP Physics by Concept 4&5* and *MYP Sciences by Concept 4&5*).

Of course, different kinds of surface have different properties. Highly reflective surfaces such as snow or ice, or water vapour in the form of clouds, raise the overall amount of solar radiation that is immediately reflected back into space. Conversely, land masses tend to absorb the energy. Human-made surfaces such as asphalt are highly efficient absorbers – as you may have noticed if you have ever seen asphalt roads melt on a hot day.

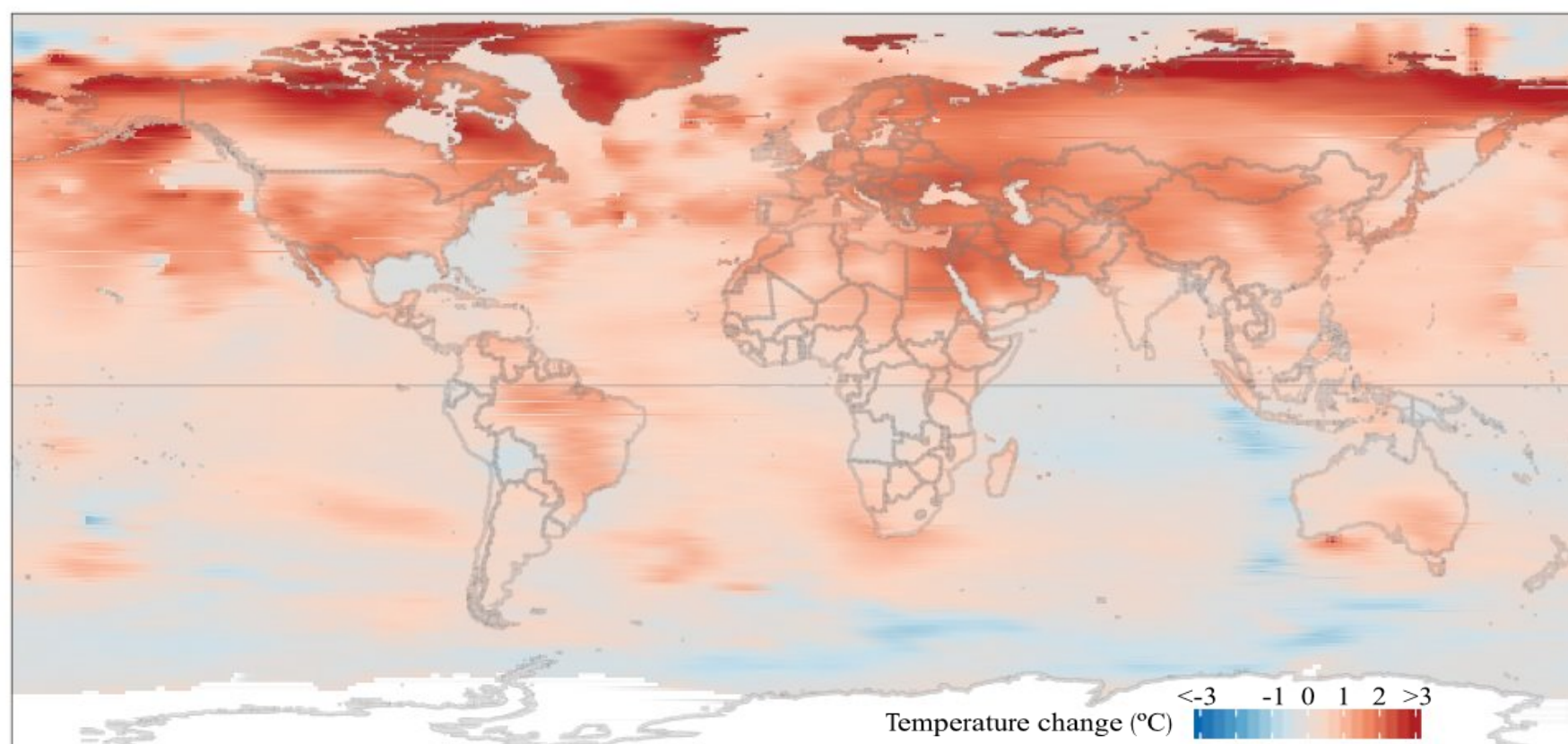
DISCUSS

Consider the following scenarios:

- **A decrease in rainfall and therefore less evaporation**
- **An increase in forest fires around the globe**
- **Catastrophic volcanic activity and therefore ash being released into the atmosphere around the globe**

Working in small groups, **describe** how the different scenarios might affect the energy exchange processes as shown in Figure 9.5. **Suggest** how they might affect the overall global atmospheric temperature. **Discuss** your thoughts.

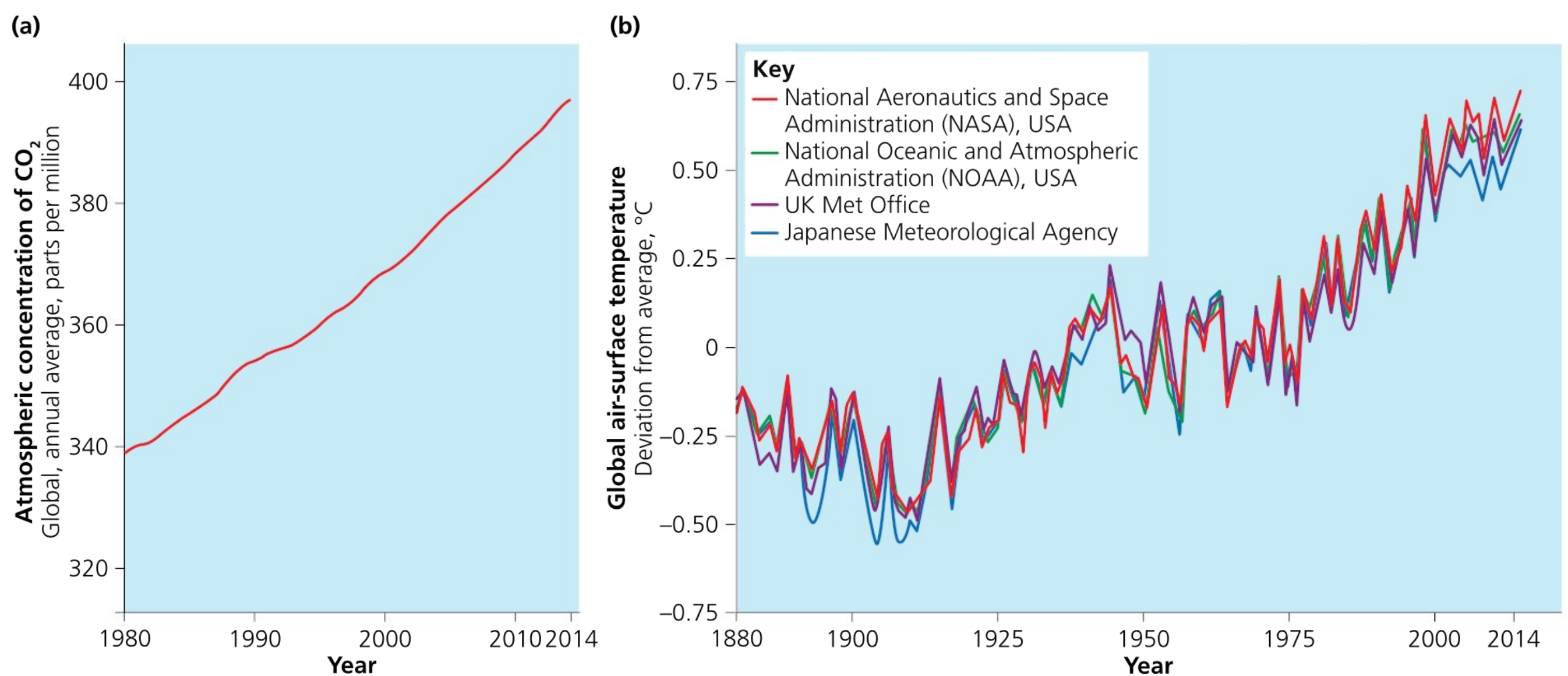
What patterns and trends give evidence for global climate change?



WHAT MAKES YOU SAY THAT?

Analyse Figures 9.6 and 9.7.
What's going on? What do you see that makes you say that?

■ **Figure 9.6** Trends in land and ocean temperatures



■ **Figure 9.7** Changes in (a) levels of CO₂ in the atmosphere and (b) air temperature

The issue of climate change has been in the news for many years now. The first scientific evidence that the Earth's climate could undergo significant changes due to natural causes was gathered in the nineteenth century with the discovery of geological evidence for the Ice Ages. But it was in the 1950s, with the introduction of new instrumentation, that scientists began to note the increase in concentration of certain greenhouse gases – particularly carbon dioxide – and it was suggested that the rate of this increase could not be attributed to natural causes. The advent of powerful computing systems in the 1960s and 1970s allowed for climate models to be developed which showed that these changes could lead to large-scale, even global shifts in the atmosphere's temperature and in weather systems.

The first United Nations conference on the Human Environment or 'Earth Summit' took place in Stockholm, Sweden in 1972, and they now occur every ten years. In 1992, in Rio de Janeiro, Brazil, the United Nations Conference on Environment and Development took place, at which the United Nations Framework Convention on Climate Change (UNFCCC) was launched. Those who signed up to the convention have met every year since 1995. During this period, scientific evidence of patterns and trends over time in temperature, carbon dioxide in the atmosphere, sea levels and other indicators have been analysed. According to NASA,

*'Ninety-seven percent of climate scientists agree that climate-warming trends over the past century are very likely due to human activities, and most of the leading scientific organizations worldwide have issued public statements endorsing this position.'*¹

<https://climate.nasa.gov/evidence/>, accessed 17 November 2018

However, some people still believe that climate change is not anthropogenic (caused by humans), but rather is a natural fluctuation in global temperature.

ACTIVITY: Making the case for the climate

■ ATL

- Information literacy skills: Make connections between various sources of information
- Critical-thinking skills: Draw reasonable conclusions and generalizations

You have been asked to **present** to a panel of government representatives the evidence for human-induced climate change. You need to be able to persuade them that the patterns and trends in the data show that climate change is occurring and that human activity has most likely caused the rapid acceleration in this change.

Use the following as the source for your data:

<https://climate.nasa.gov/vital-signs/carbon-dioxide/>

Collect three sets of data from the website that show evidence of rapid global climate change. Choose from carbon dioxide, global temperature, Arctic ice sheet minimum, ice sheets and sea level.

Describe what the graphs/maps show.

Explain how the data show that there is climate change due to humans. Consider also how the counterclaim might be made: could the data be **explained** using natural causes?

Hint

Look at the longer-term data from many years.

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion B: Investigating and Criterion C: Communicating.

What natural causes are there for climate change?

THINK–PAIR–SHARE

How do you think the events shown in the three images in Figure 9.8 might affect the Earth's climate?

As we have seen, the evidence for the rapid global climate change overwhelmingly points to human causes. However, some natural occurrences certainly do change the global temperature. Any changes in the atmosphere will result in changes in the Earth's energy balance. Changes in the atmosphere are known as forcings (see *MYP Sciences by Concept 3* and *4&5* for more on the scientific background for these processes). Natural forcings include sunspot activity, natural changes in the **albedo effect**, massive volcanic eruptions, ocean currents and natural methane release. We will be investigating how each of these can naturally change the global climate.

SUNSPOTS

Every 11 years or so the temperature of the Earth increases slightly. At these times, the Sun has relatively cooler parts on the surface (that appear to be less luminous), known as sunspots. During this time, there is more electromagnetic activity, and solar flares occur which can transfer more solar energy to the Earth.

ALBEDO EFFECT

Albedo describes the reflectivity of a surface to incident radiation. Lighter surfaces have a higher albedo and therefore reflect more of the Sun's energy back, thus reducing the amount that can be absorbed and re-emitted as warming longwave radiation.

VOLCANIC ERUPTIONS

Figure 9.9 shows the temperature change before and after the eruption of Mount Pinatubo. Within a month, the temperature dropped, and by the start of 1991, the temperature change was at 0.5 degrees below the average. This change seems very slight, but it did have some effect on the weather across the globe. This is only temporary climate change compared to the changes that are forecast, and is known as global dimming.

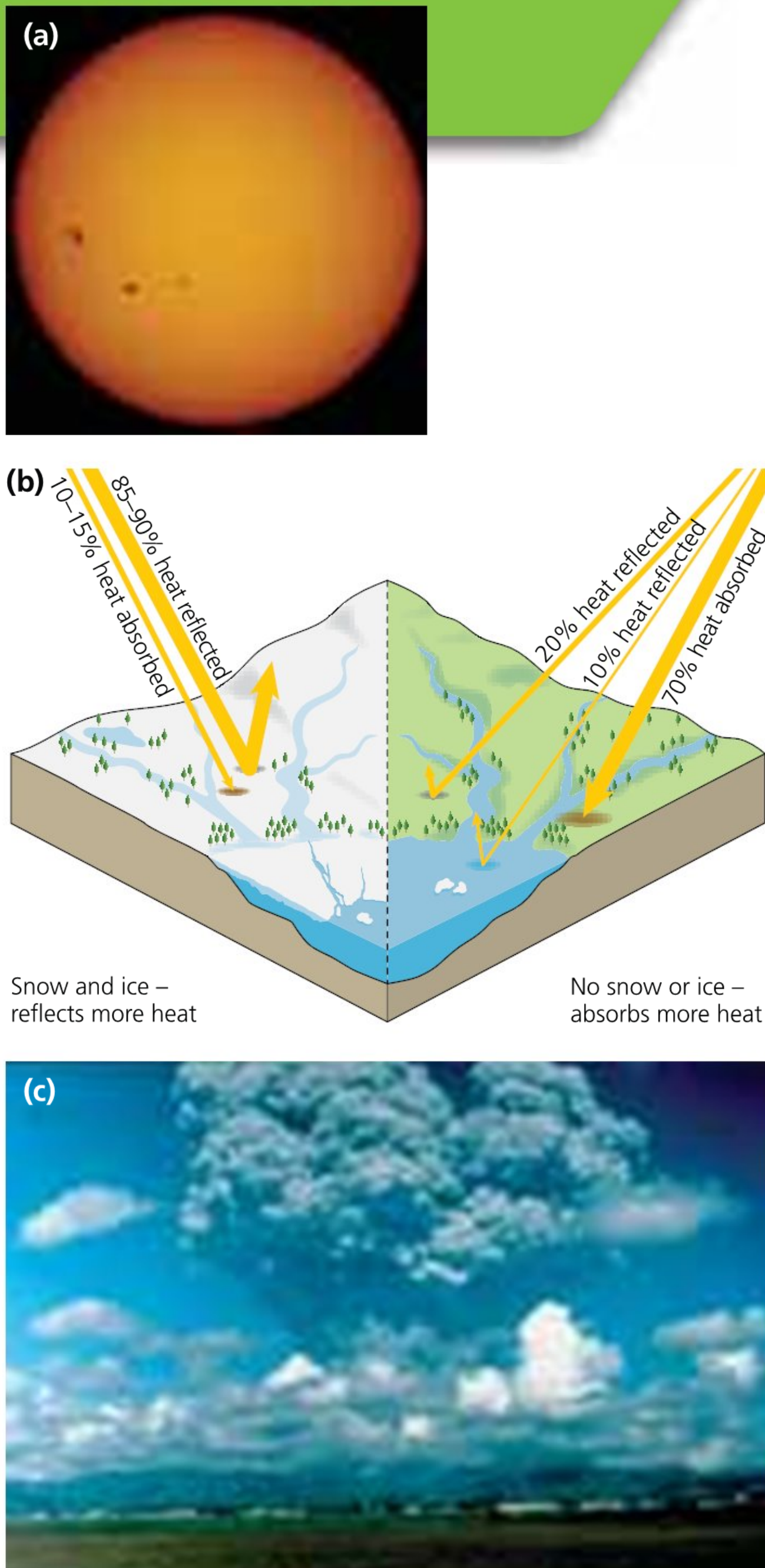


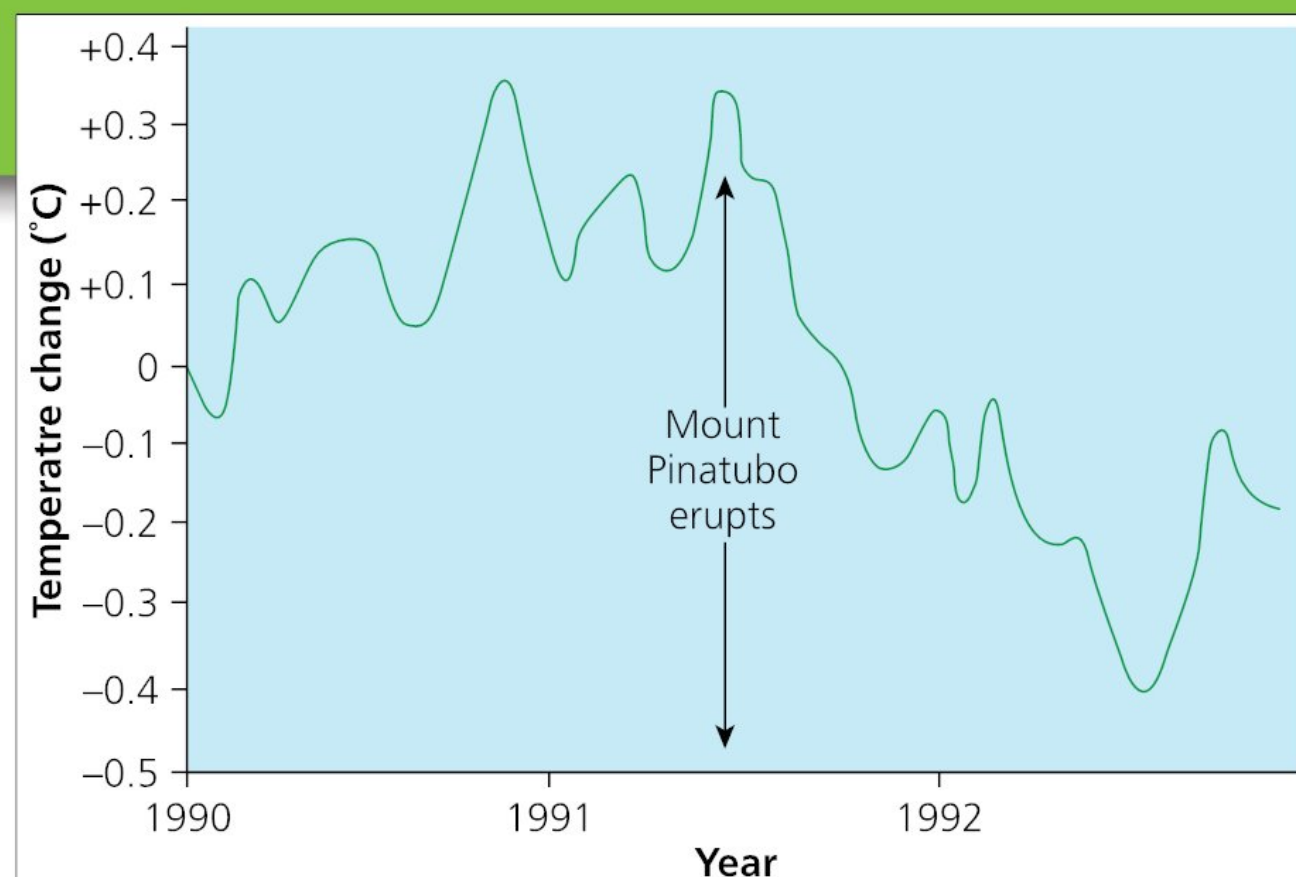
Figure 9.8 Natural causes of climate change: **(a)** sunspots, **(b)** the albedo effect on the Earth's surface, **(c)** Mount Pinatubo in the Philippines erupting in 1991

NATURAL METHANE RELEASE

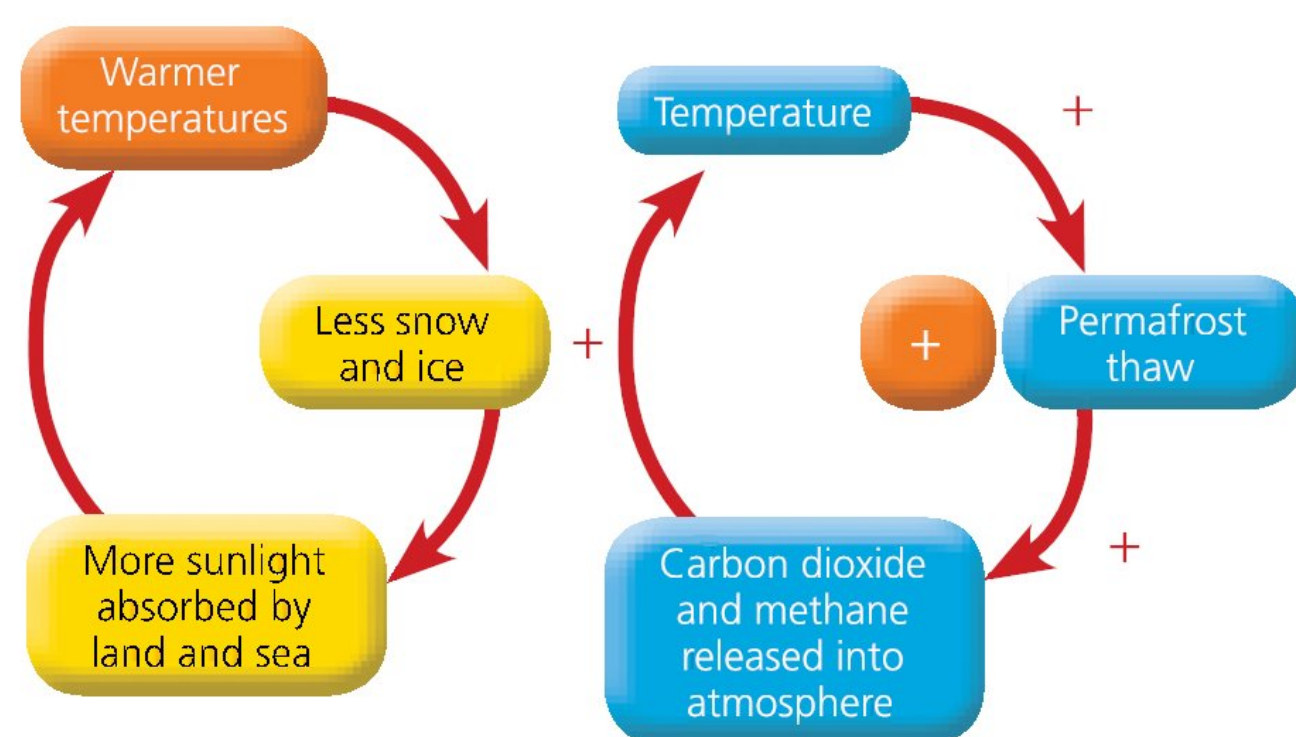
Although the concentration of methane in the atmosphere is relatively small, methane is a strong absorber of infra-red radiation and as such it has a significant impact on the global climate. Methane is produced by many natural processes, and is also trapped in natural methane 'sinks'. It can be produced by decomposition of organic matter in marshes and other wetlands, and by aerobic digestion in the guts of animals. Naturally produced methane is trapped in ice in Arctic polar regions, especially in the layer of **permafrost**. When global warming occurs, the rate of natural methane production increases; but also, methane that has been trapped for thousands of years in the Arctic sinks is released as the ice and permafrost melt.

This is an example of a positive feedback loop in climate change. Positive feedback means that the effect of an input to a system is to cause an increase in the input. So, as global warming occurs, the amount of methane released into the atmosphere increases, which causes greater global warming. Note that 'positive' feedback loops do not necessarily produce positive outcomes!

Figure 9.10 shows the positive feedback loop in the climate system.



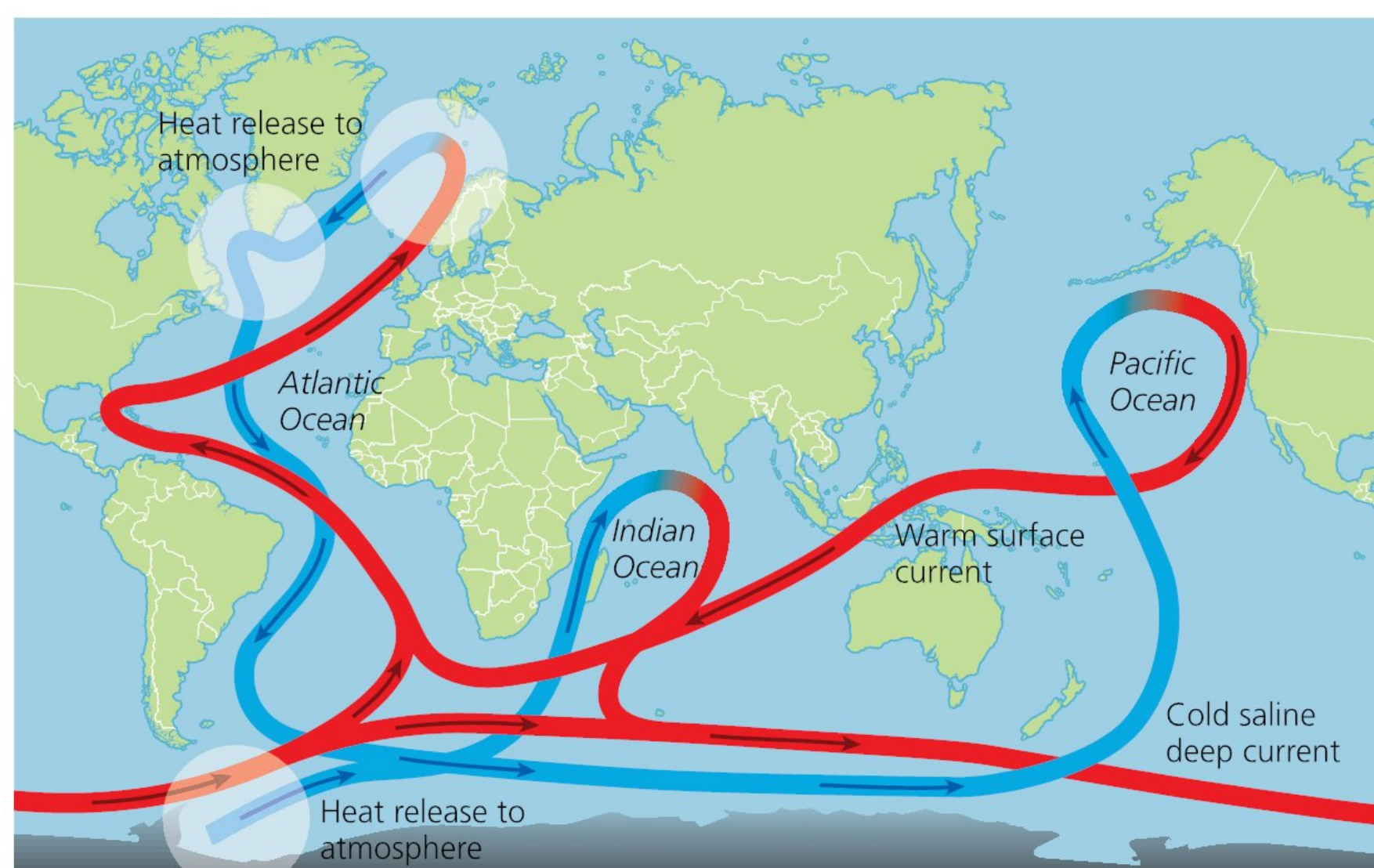
■ **Figure 9.9** Global temperature change before and after the Mount Pinatubo eruption of 1991



■ **Figure 9.10** Positive feedback in the climate system for the albedo effect and methane release

OCEAN CURRENTS

Ocean currents affect our climate. Where there are warm currents there is warmer air. This leads to **low air pressure**, which brings warm, moist air. Figure 9.11 shows how the climate of the west of Europe is influenced by the Atlantic Ocean current flowing from the Gulf of Mexico.



■ **Figure 9.11** The great ocean conveyor belt

What are the main human causes of climate change?

How do we know that climate change has been mainly caused by human activity, or what is also known as the **enhanced greenhouse effect**? Since the Industrial Revolution in Britain and elsewhere, there has been an increase in carbon emissions in the atmosphere.

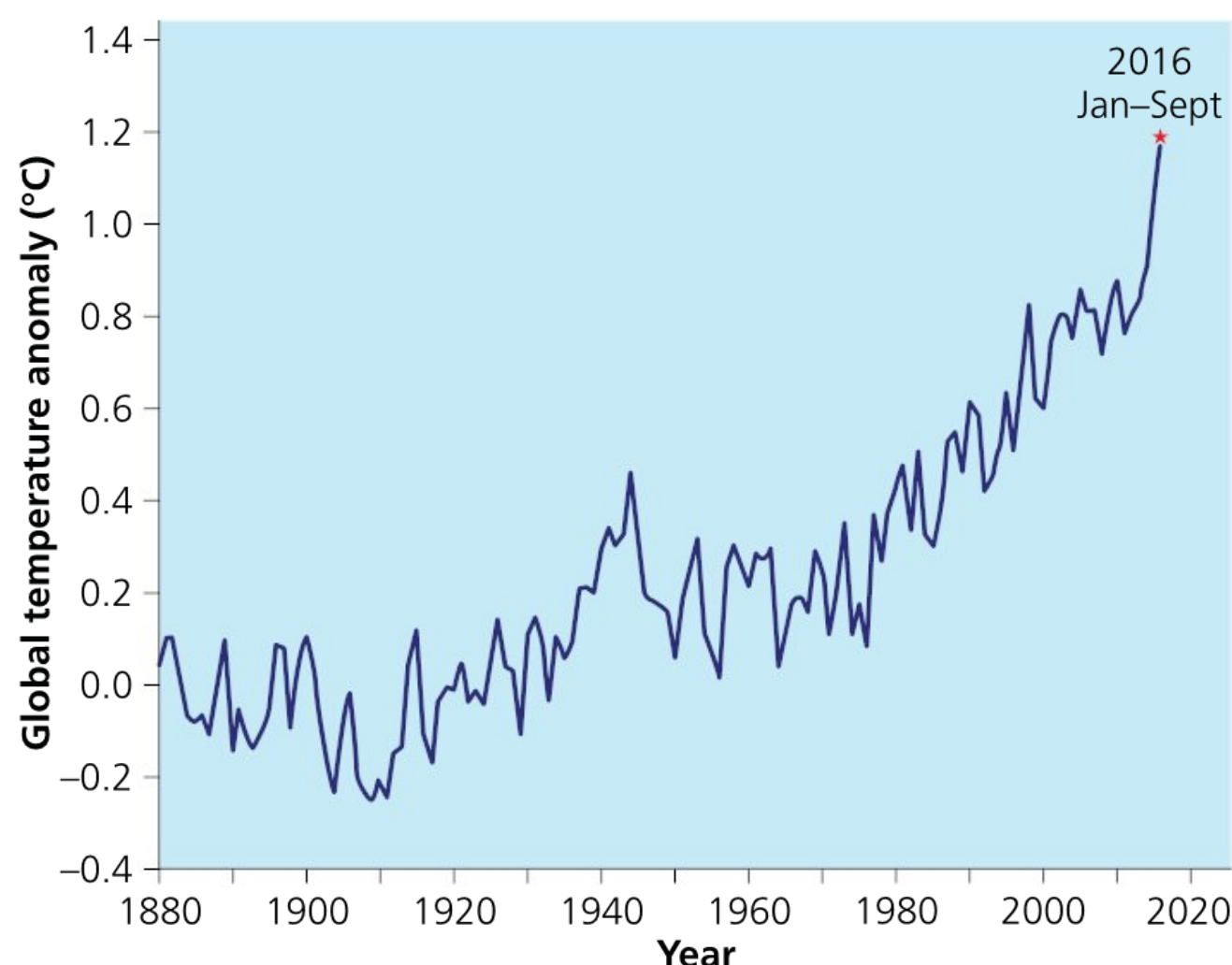


Figure 9.12 Global temperature change
Source: World Meteorological Organization

The two graphs in Figures 9.12 and 9.13 suggest that there is a correlation between the amount of carbon emission and the increase in the Earth's temperature. While a correlation does not necessarily prove a causal connection, science does show that increased carbon dioxide in the atmosphere results in increased absorption and retention of energy from longwave radiation. We have seen that there are natural cycles and events that can change the temperature. However, these changes have increased dramatically in the last two centuries.

Take action: Counting the cost

ATL

- Collaboration skills: Build consensus; Make fair and equitable decisions; Listen actively to other perspectives and ideas

THINK-PAIR-SHARE

- ! Individually, then in pairs, brainstorm different ways in which humans can increase the amount of greenhouse gases in the atmosphere. Share your ideas with the class.
- ! As a class, produce a tally chart for all the different ways in which humans can increase the concentration of greenhouse gases.
 - ◆ How many ways can be reduced by everyday changes in people's lifestyle?

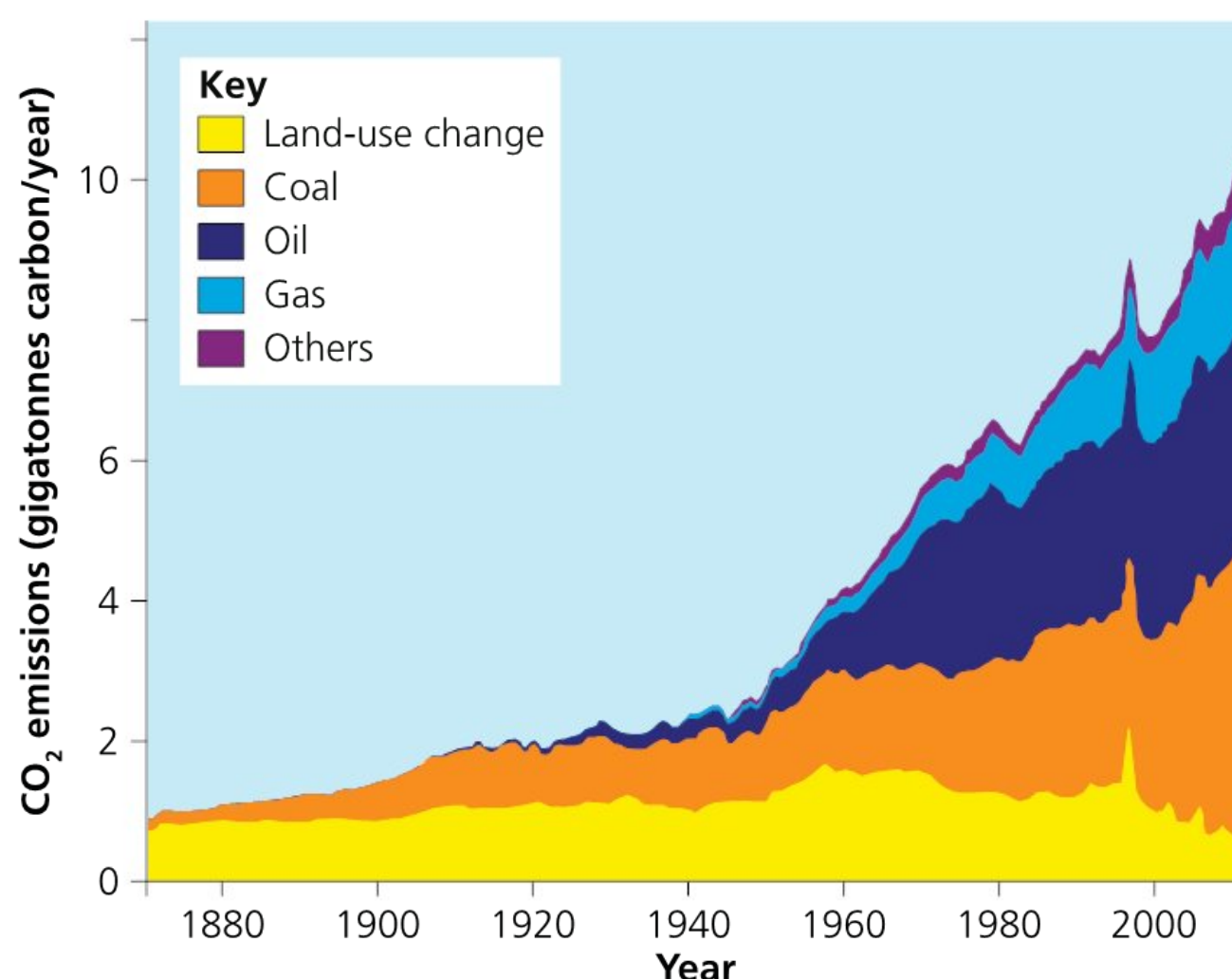


Figure 9.13 Global carbon emissions
Source: The Global Carbon Project

DISCUSS

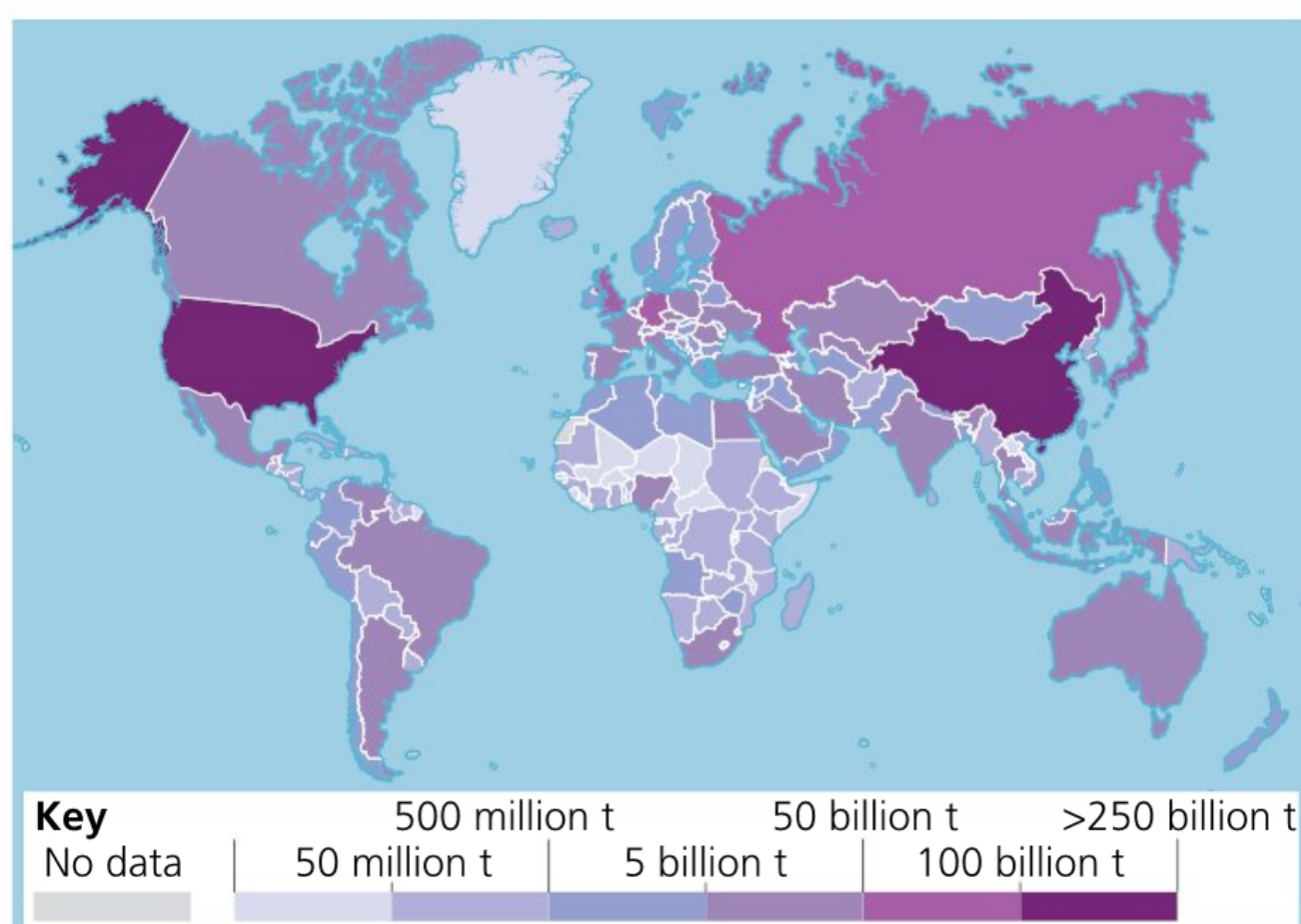
Compare and contrast the two graphs in Figures 9.12 and 9.13. What correlations do you observe? What might you **deduce**?

- ◆ How many can be reduced by laws or regulations for industry?
 - ◆ How many can be tackled locally?
 - ◆ How many require global agreements to be reduced?
- ! As a class, come up with ways in which you could encourage the different members of the school community to be aware of the impact of their lifestyle choices on the amount of greenhouse gases in the atmosphere. Prepare a campaign to raise awareness: produce posters to place around school, plan an assembly or make a video presentation

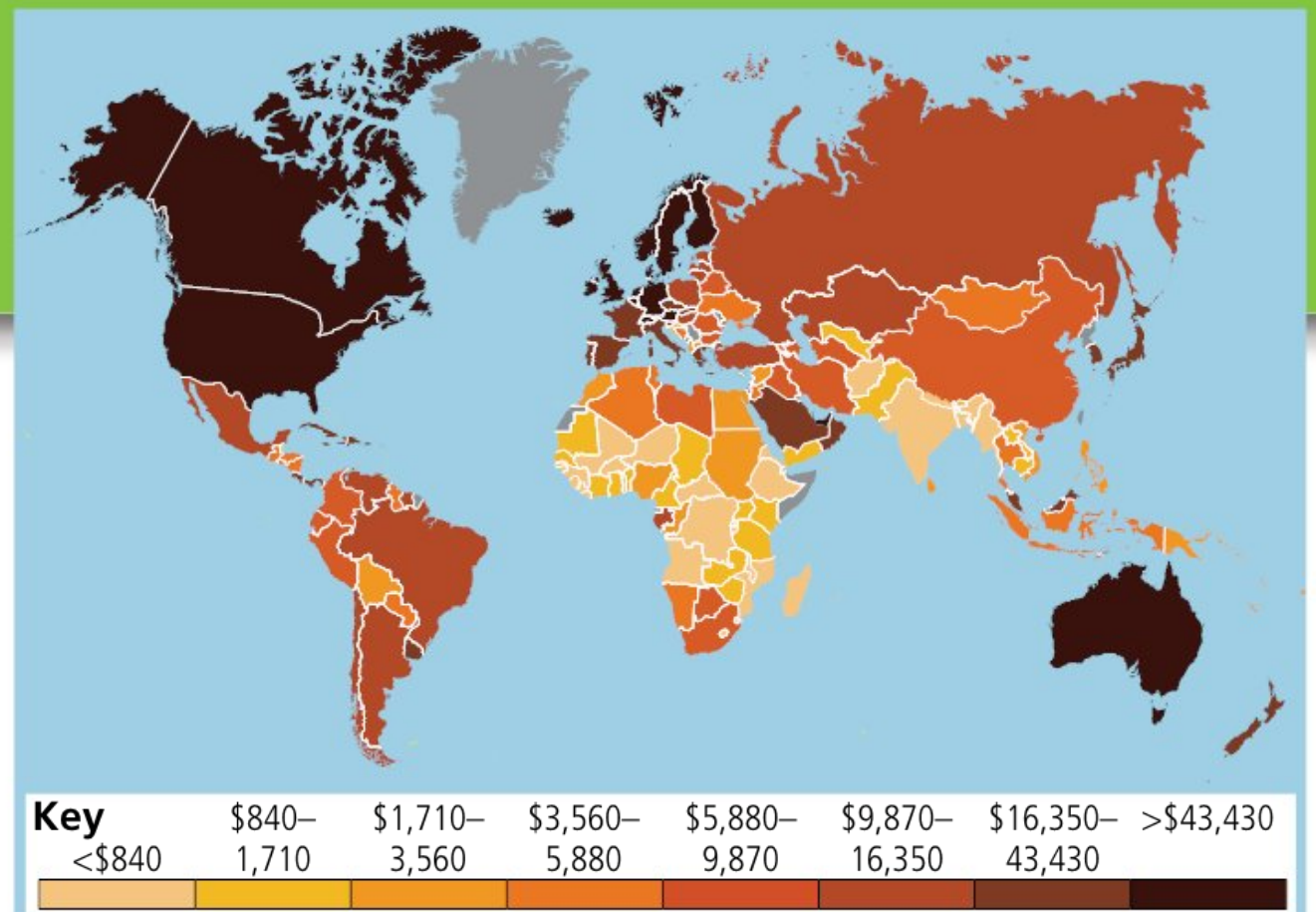
◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion C: Communicating.

The increase in greenhouse gases is in many ways due to an increase in wealth; it reflects an increase in consumer goods, the production of which leads to carbon emissions. Examples include mobile devices, and products that themselves directly contribute to the production of carbon, such as vehicles (and a more global society requires more transportation). Figures 9.14 and 9.15 show world maps for carbon dioxide emissions and **Gross National Product (GNP)** per capita.



■ **Figure 9.14** Global distribution of CO₂ emissions



■ **Figure 9.15** Global distribution of GNP per capita, 1995

ACTIVITY: Guilty riches

■ ATL

■ Critical-thinking skills: Interpret data

- 1 **Describe the distribution on the world map showing carbon dioxide emissions (Figure 9.14).**
- 2 **Describe the distribution on the world map showing GNP per capita (Figure 9.15).**
- 3 **Compare and contrast the two maps.**

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding.



DESCRIBING WORLD MAPS

When describing a world map, there are several points you should cover.

- What are the highest and lowest figures? Which regions have the highest? **State** what the figures are and where they are found.
- Sometimes you are asked to **compare and contrast**. To **compare**, **suggest** where there is a correlation between the highest and lowest quantities on both maps.
- To **contrast**, **state** where the data do not match. This is known as an anomaly.

As you can see, not all countries with a high GNP have high greenhouse emissions. Some countries have invested in green energy, such as wind power, which lowers their greenhouse gases emissions. Others – such as France – rely on other low-carbon energy resources such as nuclear power.

However, an increase in wealth usually means an increase in greenhouse emissions. Around 1750, at the start of the Industrial Revolution, the burning of coal and then other fossil fuels increased. Then the development of the combustion engine increased the release of greenhouse gases into the atmosphere. The number of factories that burnt coal, gas and oil or that used energy that was produced using fossil fuels, continually increased. As nations become wealthier, we tend to see an increase in the number of cities. Another problem has been the increase in consumption of protein in the form of meat which in turn increases the amount of deforestation as land is sought to rear livestock. Goods being shipped have increased, and this again leads to more greenhouse gases.

DISCUSS

In the section on natural forcings (see page 202), we looked at the positive feedback loop produced by the release of natural methane gas. **Identify** and **discuss** any human causes which may also produce positive feedback loops in global warming.

ACTIVITY: 3–2–1 BRIDGE

Causes of climate change

Go back to your 3–2–1 bridge routine at the beginning of this chapter and go through the process again. Have your ideas about climate change altered?

Individually, write down:

- **3 thoughts**
- **2 questions**
- **1 analogy**

... about the causes of global climate change.

Share your ideas with the class. In what ways are your ideas the same? In what ways are they different?

Has your understanding of the causes of climate change altered? If so, how?

What are the consequences of climate change?

GEOGRAPHICAL CONSEQUENCES OF CLIMATE CHANGE

We have seen that the global temperature has not changed much over time, but that it is now increasing at an unprecedented rate, due to an increase in greenhouse gases released because of human activity. This increase has consequences, some that are known to be already happening, and some that are predicted. And scientists are discovering new consequences all the time.

ACTIVITY: Consequences of climate change

■ ATL

- Creative-thinking skills: Use brainstorming and visual diagrams to generate new ideas and inquiries

California fires: Camp fire death toll rises to 71 with more than 1,000 missing

www.theguardian.com, 17 November 2018

HEATWAVE: 2018 WAS THE JOINT HOTTEST SUMMER FOR UK

BBC, 3 September 2018

Climate change is making storms like Hurricane Florence worse

CNN, 19 September 2018

■ **Figure 9.16** Some newspaper headlines for the year 2018

Use a table, a Venn diagram or another visual organizer. **Classify** the newspaper headlines in Figure 9.16, and other headlines from around the world from your own research into the impacts of climate change, into the following categories – consequences that:

- affect both high- and low-income countries
- affect the oceans and ice (**hydrosphere** and **cryosphere**)
- affect the land (**biosphere**)
- affect the atmosphere
- have affected people (social)
- affect the economy
- affect just the environment
- affect governments (politics).

Hint

You may find that some consequences fall into multiple categories!

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion C: Communicating and Criterion D: Thinking critically.

THINK–PUZZLE–EXPLORE

Read the headline in Figure 9.17.

Ship sets record for earliest crossing of notorious Northwest Passage through Arctic

www.independent.co.uk/news, 30 July 2017

■ **Figure 9.17** A news website headline

What do you think you know about the topic that the headline is referring to?

What questions or puzzles do you have about the headline?

How can you **explore** this headline further?

CONSEQUENCES FOR THE CRYOSPHERE AND THE HYDROSPHERE

Ice

We all know what happens to ice when it heats up. Water has an unusual property, however: it is one of the very few substances whose solid state (ice) occupies a greater volume than its liquid state. This means that when ice melts, it actually reduces the volume occupied. This is why icebergs float on water – they are less dense than the water around them. Consequently, melting sea ice will not raise sea levels globally.

However, the vast majority of surface ice is in the form of snow and ice that is currently lying on land. If this ice melts, the water will run into the oceans and result in an increase in sea level globally.

ACTIVITY: Exploring the impacts of sea level rise using GIS

■ ATL

- Information literacy skills: Understand and use technology systems
- Critical-thinking skills: Use models and simulations to explore complex systems and issues

Work individually or in pairs.

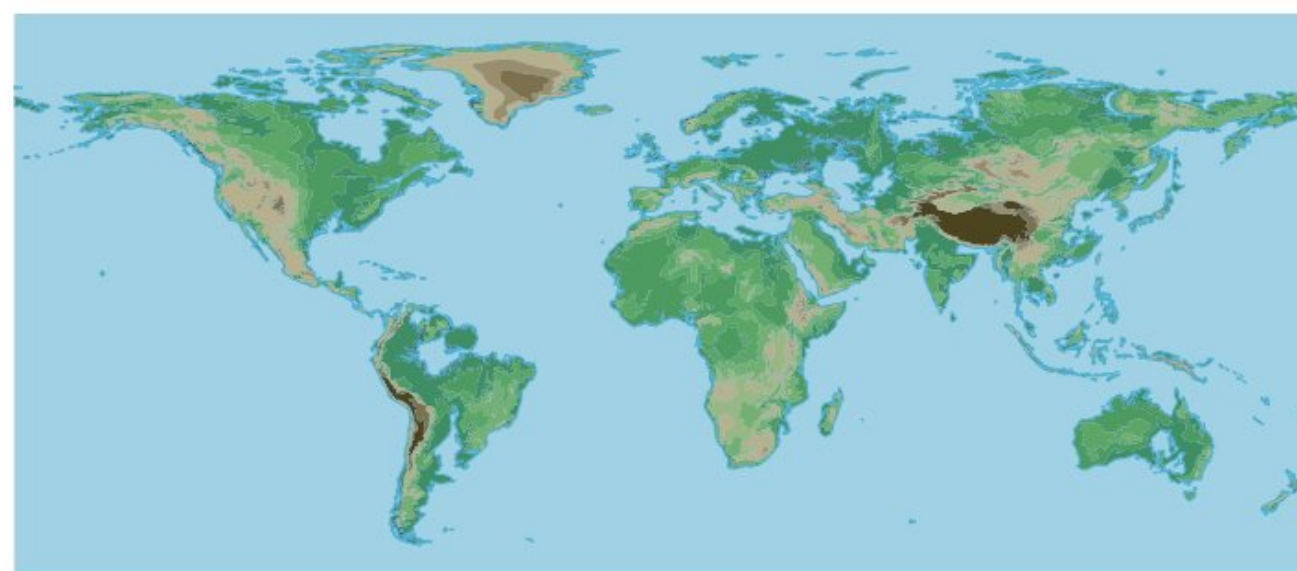
Study Figure 9.18 that shows the regions around the world that could be affected if the sea level continues to rise. **Compare and contrast** this to a map of the world as it is today.

Use ArcGIS Online to help you **investigate** three or four affected regions and **describe** the impacts for each region.

To **create** the map shown in Figure 9.18, open a new ArcGIS Online map and search *three map layers* using the following terms:

- Population Density 2015 tiles
- Sea Level Rise 5m base tiles
- Global Sea Level Rise 1 Metre
- Wealth Distribution

Once added to your ArcGIS Online map, your map content should look like Figure 9.19.



■ **Figure 9.18** Regions around the world that could be affected with a 100-metre sea level rise



■ **Figure 9.19** Map content panel

Refer back to pages 18–19 if you need to learn how to add layers and turn them on and off on ArcGIS Online.

Use the four layers on your newly created map and simple GIS tools to help you **discuss** the following:

- **What are the social, economic, environmental and political (SEEP) impacts in each chosen region?** (See Figure 1.44 on page 26 for more on SEEP.)
- **What other impacts can you think of?**

Share your ideas with the class. Do you all agree about the impacts?

Figure 9.20 shows photos of the retreating Waggonwaybreen glacier in Svalbard, Norway. Not only are these and other glaciers retreating, but their thickness is also decreasing. Once a glacier starts to melt or retreat there are several impacts: rising sea level, loss of habitat

for humans and animals, the slopes in mountain areas becoming unstable, and landslides. People lose income due to ski resorts closing.



■ **Figure 9.20** The retreating Waggonwaybreen glacier in Svalbard, Norway

Research

Use the following website to **find** out some of the consequences of glacier melting in different regions of the world: <https://phys.org/news/2017-05-glaciers.html>

Use the SEEP categories to help you **organize** your information.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.

Oceans (acidification): evidence

As atmospheric CO₂ increases, more carbon dioxide is dissolved in seawater. This results in the creation of carbonic acid and a decrease in pH as the oceans become more acidic. As many creatures in the sea have shells made from calcium carbonate, this increase in acidity has a detrimental effect on the development of their shells. Many crustacean species have declined in recent years. Marine food webs are affected by the crustacean population decreasing, and this has an impact on fishing regions. Coral bleaching also occurs, as the coral cannot develop its skeleton, and again this has a negative impact on sea life in coral regions.

EXTENSION

Find out how ocean acidification is affecting ecosystems in one part of the world. Search, for example, **bleaching Great Barrier Reef**.

ACTIVITY: Mapping impacts

■ ATL

- Creative-thinking skills: Use brainstorming and visual diagrams to generate new ideas and inquiries

Create a concept map to show the social, economic, environmental and political impacts of acidification.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding, Criterion C: Communicating and Criterion D: Thinking critically.

Carbon stored in ice: permafrost melting

As the global temperature is increasing, the permafrost regions are starting to melt. As the ice thaws, methane that has been trapped underground for millions of years has started to leak out. As we saw earlier (page 203), this results in a positive feedback loop in the global warming process.

GENERATE–SORT–CONNECT–ELABORATE

Generate the consequences for the hydrosphere and cryosphere of the permafrost melting.

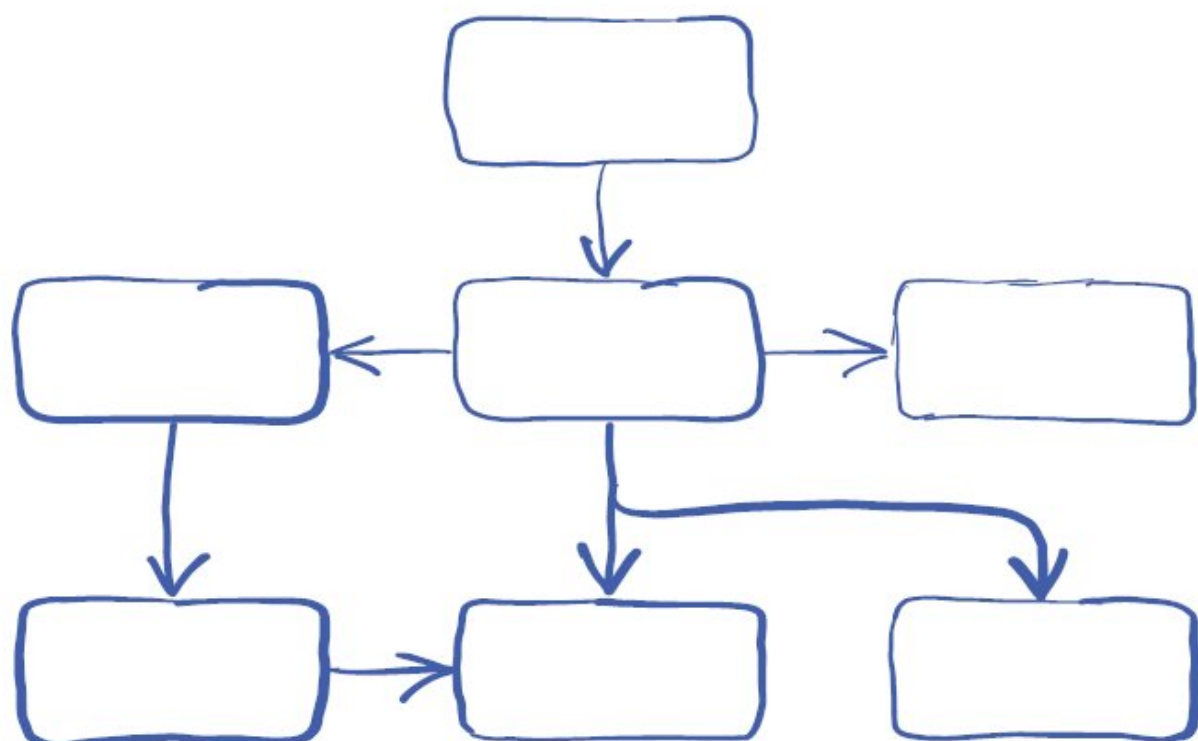
Sort them into short-term and long-term consequences.

Connect the short- and long-term consequences into social, economic, environmental and political.

Elaborate on your findings and any new consequences.

DRAWING CONCEPT MAPS

To **draw** a concept map that links the four geographical categories (social, economic, environmental and political), choose four colours and use each one to represent a different impact. Figure 9.21 shows a hand-drawn concept map; alternatively, you can use one of the many apps and programmes that are available to do this.



■ **Figure 9.21** Outline for a concept map

CONSEQUENCES THAT AFFECT THE BIOSPHERE

The biosphere encompasses the areas of the globe where life occurs – whether on the Earth’s surface or in the air.

Global temperature increase has had a wide impact on the biosphere, and on living conditions. Some might even say that the consequences are not all bad.

THINK–PAIR–SHARE

Read the headlines in Figure 9.16 (page 207) on your own. What do you think about the year 2018? Was it a year that saw many climate change consequences? Were all these consequences negative? If there were some positive effects, what were they and why do you think they are positive? Which areas of the world experienced the most significant impact?

Share your ideas a partner. Then share with the rest of the class. Are there any points you can all agree on? Are there any differences of opinion?

Global spatial changes in biomes and habitats

One of the many effects that have been observed as a result of climate change is that the locations of certain biomes have changed. One example is the mountain biomes. Many glaciers in mountainous regions have reduced in size; this has had an effect on flora and fauna in these ecosystems. Some species of plant have dropped in number due to competition from other plant species that can now live in higher altitudes due to the warmer climate. (See <http://sciencenordic.com/climate-change-alters-mountain-plants> for an example of research that has shown that some high-altitude plants in the Alps have declined in number.) With the change in plant species comes a change in animal species and numbers.

In the tropical regions of the world, warming can bring an increase in the number of insects, such as the mosquito. It has been observed that in specific elevations the number of mosquitos has increased, and in certain parts of these areas, tropical diseases such as malaria have increased.

Global spatial changes to agriculture

Climate change and human activity can work together to increase the impact on the land. One of the most significant areas that have been affected by climate change is the Sahel in sub-Saharan Africa. With the temperature increase and issues of overgrazing and cultivation, the land has become desertified. With an ever-increasing population and the associated needs for more resources such as fuel and food, more and more land is exposed to the warmer and drier climate, which in turn leads to further desertification.

In other parts of the world, climate change has changed the nature of farming. New crops have taken over from older ones; yields grow as there is a longer growing season, which seems to be a positive consequence. However, this change also impacts on animal life in these regions and therefore the food chain. Some farms might benefit from this change, while others might lose their livelihood.

! Take action: Focus on malaria

■ ATL

■ Information literacy skills: Access information to be informed and inform others

- ! Malaria is a widespread disease that is caused by microorganisms that are spread by mosquitos. While some people in areas where malaria is prevalent have developed natural immunity, as global warming occurs, mosquitos are moving to new locations.
- ! Research into the impact of malaria in highland regions. Use the two websites below as a guide:
 - ◆ www.bbc.co.uk/news/health-26470755
 - ◆ www.independent.co.uk/news/science/climate-change-is-increasing-the-risk-of-malaria-for-people-living-in-mountainous-regions-in-the-9174448.html

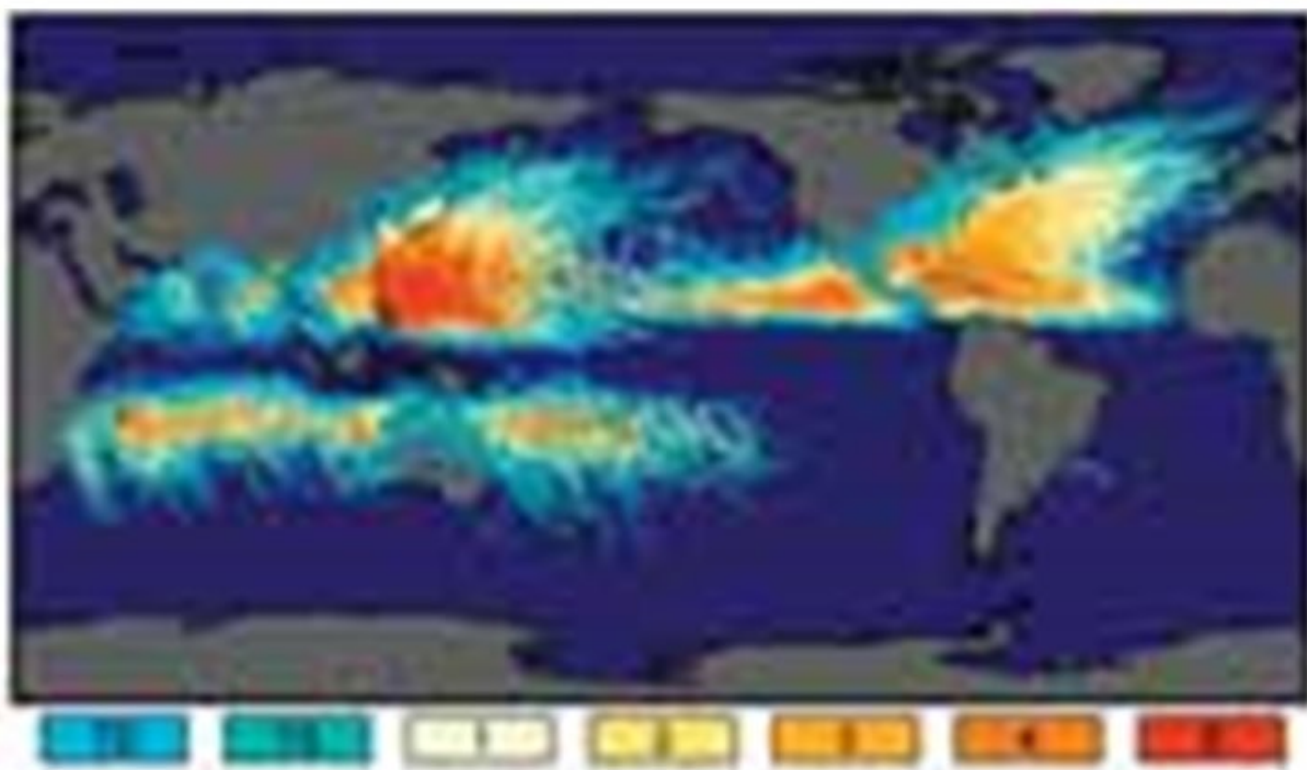
- ! Then see if you can find any others. (Remember to assess how reliable the websites are before you use them.)
 - ◆ Take action by raising awareness: **Present** your research in such a way as to raise awareness about the impact of malaria in these regions.
 - ◆ Take action by fundraising: Can you take action to help people in these regions? Look for opportunities to support charities or other organizations who are working to combat malaria.
 - ◆ Take action directly: If you live in an area where malaria is endemic, can you help people by providing access to anti-malaria or anti-mosquito treatments?

CONSEQUENCES THAT AFFECT THE ATMOSPHERE

Incidence and severity of extreme weather events

In 2018 there were many extreme weather events, from forest fires in California, to a heatwave in Europe, drought in Australia, flooding in Bangladesh, and an increase and intensity of tropical cyclones.

Figure 9.22 shows the number and intensity of hurricanes around the globe. The image is from an American website, and therefore the term 'hurricane' is used. However, these storms are not called hurricanes in all parts of the world. In the North Pacific, they are known as typhoons; in the Atlantic, they are known as hurricanes, and in and around the Indian Ocean, they are known as cyclones. They are, however, all the same: areas of very low pressure with high winds and heavy rain that develop over warm ocean regions.



Saffir-Simpson hurricane intensity scale

■ **Figure 9.22** The number of tropical storms (showing their tracks) and their intensity

Over the years, the number and intensity of these weather events have increased. It is believed that with an increase in atmospheric temperature, the temperature of the upper part of the ocean is also increasing. This leads to an increase in levels of evaporation and therefore lower air pressure. These effects in turn mean more torrential rainfall and higher winds. The impact of these more frequent and intense storms has been devastating in many coastal communities.

Drought

In 2018, regions such as Australia, California and Europe experienced one of the hottest summers on record. Drought, heatwaves and forest fires dominated headlines in many high-income countries.

■ ATL

■ Communication skills: Structure information in summaries, essays and reports

You are going to write an essay in which you **evaluate** the social, economic, environmental and political (SEEP) consequences of climate change. (See Figure 1.44 on page 26 for more on SEEP.) Remember to be balanced in your evaluation, not just focusing on one side.

Decide how you are going to **organize** your findings. You may choose to copy and complete Table 9.1.

Geographical factors	Positive	Negative
Social		
Economic		
Environmental		
Political		

■ **Table 9.1** The consequences of climate change

◆ Assessment opportunities

◆ This activity can be assessed using Criterion A: Knowing and understanding, Criterion C: Communicating and Criterion D: Thinking critically.

EXTENSION

Research **tropical cyclone events trends**. In your research look into the following: Have storms increased in intensity (wind speed and rainfall)? Have more storms occurred **compared** to the past? Have the impacts on people been greater than in the past? (Look for data on the number on deaths, the number of homes affected and the money spent on rebuilding after the storm.)

EXTENSION

Research the impacts that the increase in temperature has had on certain areas. Use the links below to help you begin your notes:

- www.bbc.co.uk/news/av/world-europe-40829480/why-europe-s-heatwave-is-so-dangerous
- <https://abcnews.go.com/Politics/climate-change-make-wildfires-spread-factor/story?id=56937704>
- www.bbc.co.uk/news/world-australia-45107504

Can we manage global climate change consequences?

SENTENCE-PHRASE-WORD

Search the two words **mitigation** and **adaptation**.

For each word:

- write a sentence that you can use to describe what the word means
- write a phrase, a short version of the sentence
- find a word that you can use to help you understand what the word means.

Share with the class. Do you have an understanding of what mitigation and adaptation mean?

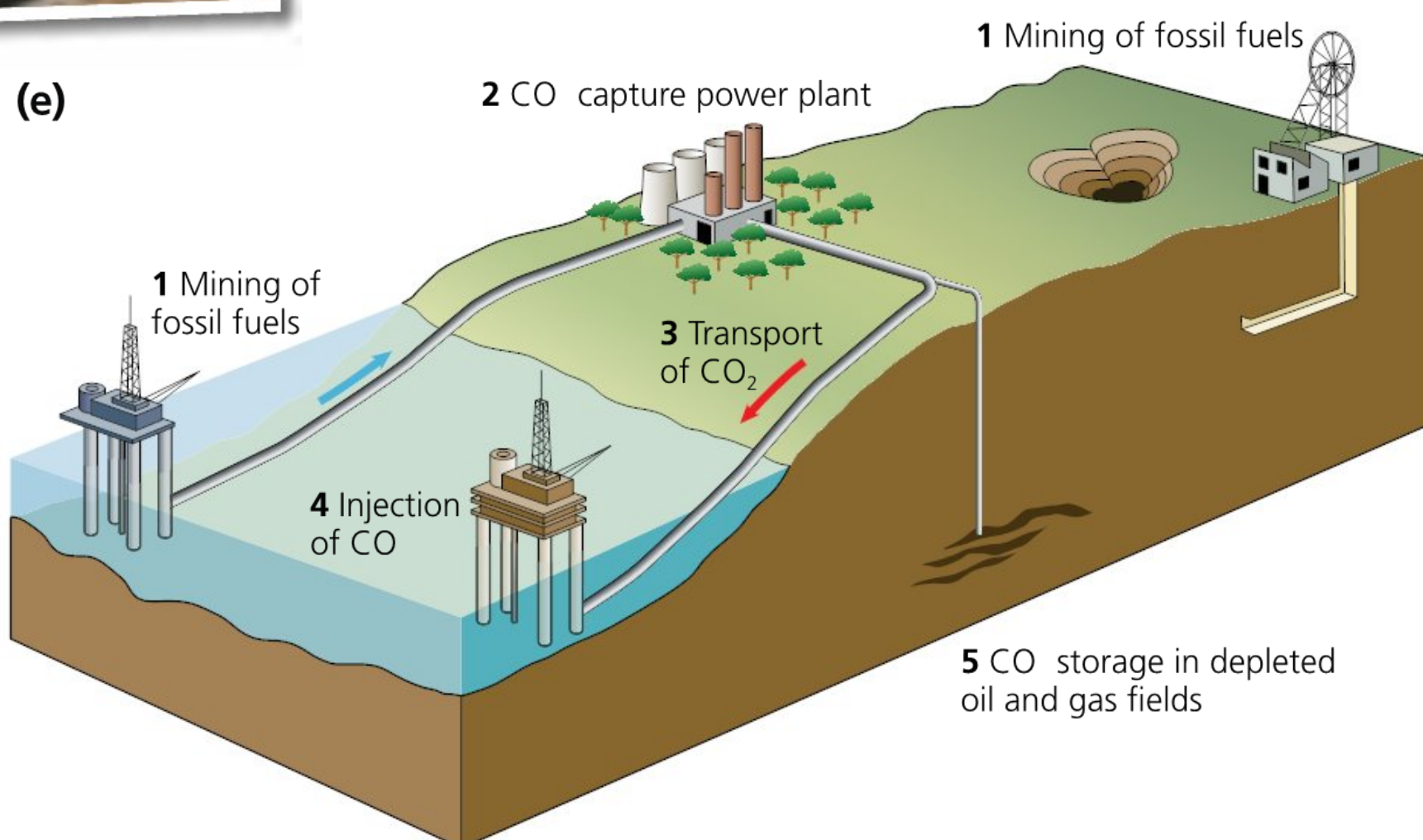


Figure 9.23 Ways of mitigating and adapting to the effects of climate change: **(a)** vertical gardens in Paris, **(b)** houses on stilts in Bangladesh, **(c)** solar panels and wind turbines, **(d)** flood defences in the Netherlands and the UK, **(e)** carbon capture

ACTIVITY: Mitigate or adapt?

■ ATL

- Critical-thinking skills: Draw reasonable conclusions and generalizations

The images in Figure 9.23 show different responses to climate change in different places.

Classify each type of response: is it mitigation or adaptation? **Explain** your choices.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding,

Now that you have established the difference between **mitigation** and adaptation, we can start to focus on how the two methods can be used as a response to climate change consequences.

Mitigation methods tend to be led by governments. Mitigation tries to reduce the number of greenhouse gases released into the atmosphere. Intergovernmental groups, such as the United Nations Framework Convention on Climate Change (UNFCCC), have produced several climate change agreements. The first Earth summit conference was in Rio in 1992. The focus of the convention was to advocate and support mitigation methods

However, in 2015 during the UN Paris agreement, the focus shifted to how countries can adapt to the impacts of climate change. Many low-income countries (LICs) need help to adapt to – and become more resilient in the face of – climate change, and the UNFCCC is there to support these governments.



■ **Figure 9.24** An infographic showing the main outcomes and some ways of achieving these outcomes from the UN Paris agreement in 2015. These are a mixture of mitigation and adaptation methods

ACTIVITY: Evaluating responses

■ ATL

- Communication skills: Make effective notes in class
- Critical-thinking skills: Draw reasonable conclusions and generalizations

Look at the five images showing different types of responses to climate change in Figure 9.23. For each type, carry out research to **find** out how they work.

Describe how they work, and their intended effect.

Evaluate them: look at the values and limitations (advantages and disadvantages) of each one.

Using a copy of Table 9.2, a Venn diagram or other suitable visual organizer, **classify** each method as social, economic, environmental or political.

		a	b	c	d	e
Social	advantage					
	disadvantage					
Economic	advantage					
	disadvantage					
Environmental	advantage					
	disadvantage					
Political	advantage					
	disadvantage					

■ Table 9.2

Try other methods to **find** out which ways you prefer to **organize** your notes when evaluating.

Write an article about different methods that are used to respond to the consequences of climate change.

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion B: Investigating, Criterion C: Communicating and Criterion D: Thinking critically.

Many countries have signed up to help reduce global warming and to help others adapt to the impacts of global warming. However, there are still many people who do not believe that climate change is happening. For us to slow the pace of the impact of climate change and global warming, governments and civil society must respond together. But, how can this be done while there are people who deny that it is happening?

Reflection

In this chapter, we have **identified** many different reasons for climate change. We have **described** and **explained** the processes that regulate the Earth’s temperature to make it habitable for us to live on the planet. We have **investigated** evidence of climate change using the trends and patterns of temperature change and **explained** the consequences of this change in temperature. We have **evaluated** ways in which we can mitigate and adapt to climate change. Finally, we have **examined** why some still do not accept that climate change is happening and how we can respond to the urgent need to slow the pace of global warming.

Use this table to reflect on your own learning in this chapter.					
Questions we asked	Answers we found	Any further questions now?			
Factual: What are the main layers of the Earth’s atmosphere? What is the energy budget? What are greenhouse gases and why are they important to the world’s climate?					
Conceptual: What patterns and trends give evidence for global climate change? What natural causes are there for climate change? What are the main human causes of climate change? What are the consequences of climate change?					
Debatable: Can we manage global climate change consequences?					
Approaches to learning you used in this chapter:	Description – what new skills did you learn?	How well did you master the skills?			
		Novice	Learner	Practitioner	Expert
Collaboration skills					
Communication skills					
Creative-thinking skills					
Critical-thinking skills					
Information literacy skills					
Learner profile disposition	Reflect on the importance of being caring for your learning in this chapter.				
Caring					

10

What happens when humans live in hazardous places?



- The **scale of impact** of a natural disaster depends on the ability of **diverse human systems** to respond in **specific places and times**.

CONSIDER THESE QUESTIONS:

Factual: What are natural hazards and natural disasters? What is the global trend in natural disasters? What are the main types of hazards?

Conceptual: How do natural hazards change in scale, magnitude and frequency? Why are some places more vulnerable than others?

Debatable: Is it ever possible to be completely prepared for natural disasters?

Now **share and compare** your thoughts and ideas with your partner, or with the whole class.

IN THIS CHAPTER, WE WILL ...

- Find out** about the difference between hazards and disasters, the global trends in natural disasters and how hazards can be classified depending on their magnitude and frequency.
- Explore** risk, vulnerability and hazard perception in contrasting places around the globe.
- Take action** on how to manage and respond when natural disasters occur.

These Approaches to Learning (ATL) skills will be useful ...

- Communication skills
- Critical-thinking skills
- Information literacy skills
- Media literacy skills
- Reflection skills
- Transfer skills

Assessment opportunities in this chapter:

- Criterion A: Knowing and understanding
- Criterion B: Investigating
- Criterion C: Communicating
- Criterion D: Thinking critically



Figure 10.1 A rescuer with his search dog after the 2011 Van earthquake in Turkey

- We will reflect on this learner profile attribute ...
- Inquirer – we will develop skills for inquiry and research.

KEY WORDS

- | | |
|----------|---------------|
| exposure | trend |
| response | vulnerability |
| risk | |

SEE–THINK–WONDER

Study Figure 10.2, which shows the aftermath of Typhoon Haiyan which struck South East Asia, and in particular the Philippines, in November 2013. It was the strongest tropical cyclone ever recorded.

What do you see? What does it make you think? What does it make you wonder?



Figure 10.2 A family in the Philippines putting their lives back together after their home was destroyed by Typhoon Haiyan in 2013

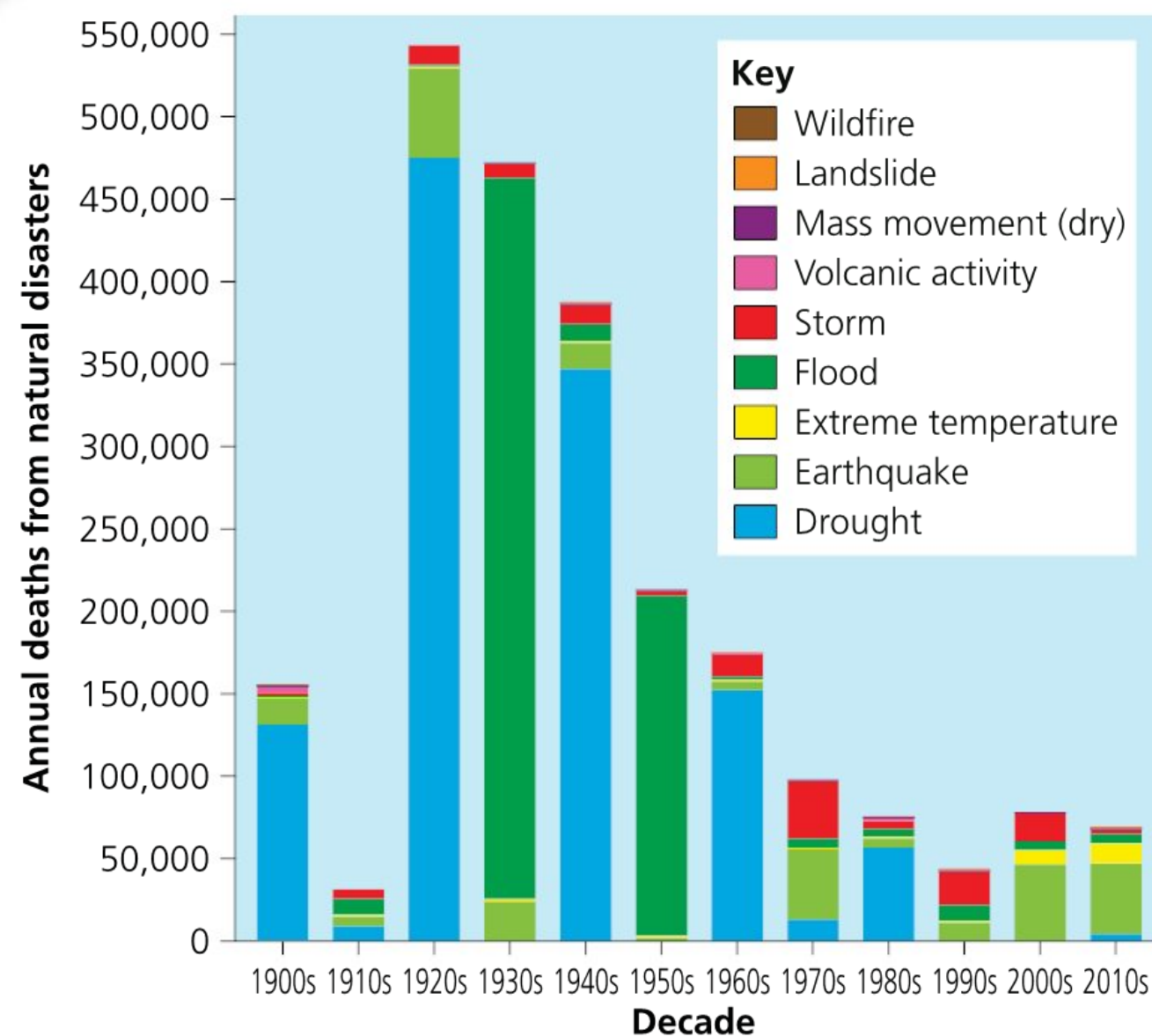
What are natural hazards and natural disasters?

DISCUSS

Look at Figure 10.3, which shows the number of global deaths from natural **disasters** since the 1900s.

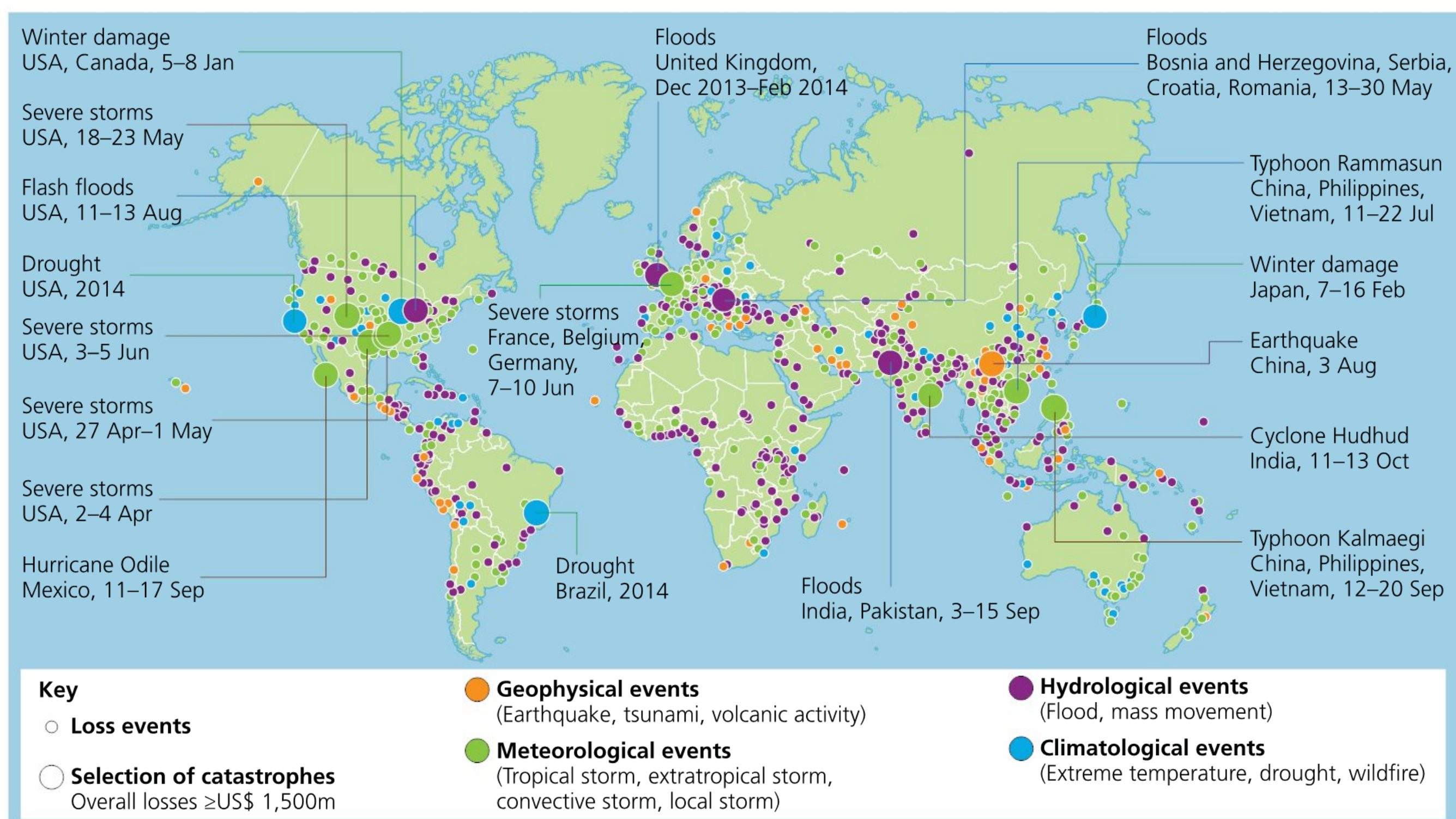
- Describe the trend in deaths from natural disasters.
- Use the key to deduce the changes in the distribution of hazards globally. How would you explain the global shift in the causes of death from disasters?

Discuss your findings.



■ **Figure 10.3** Annual global number of deaths from natural disasters per decade, 1900–2015

WHAT ARE NATURAL HAZARDS?



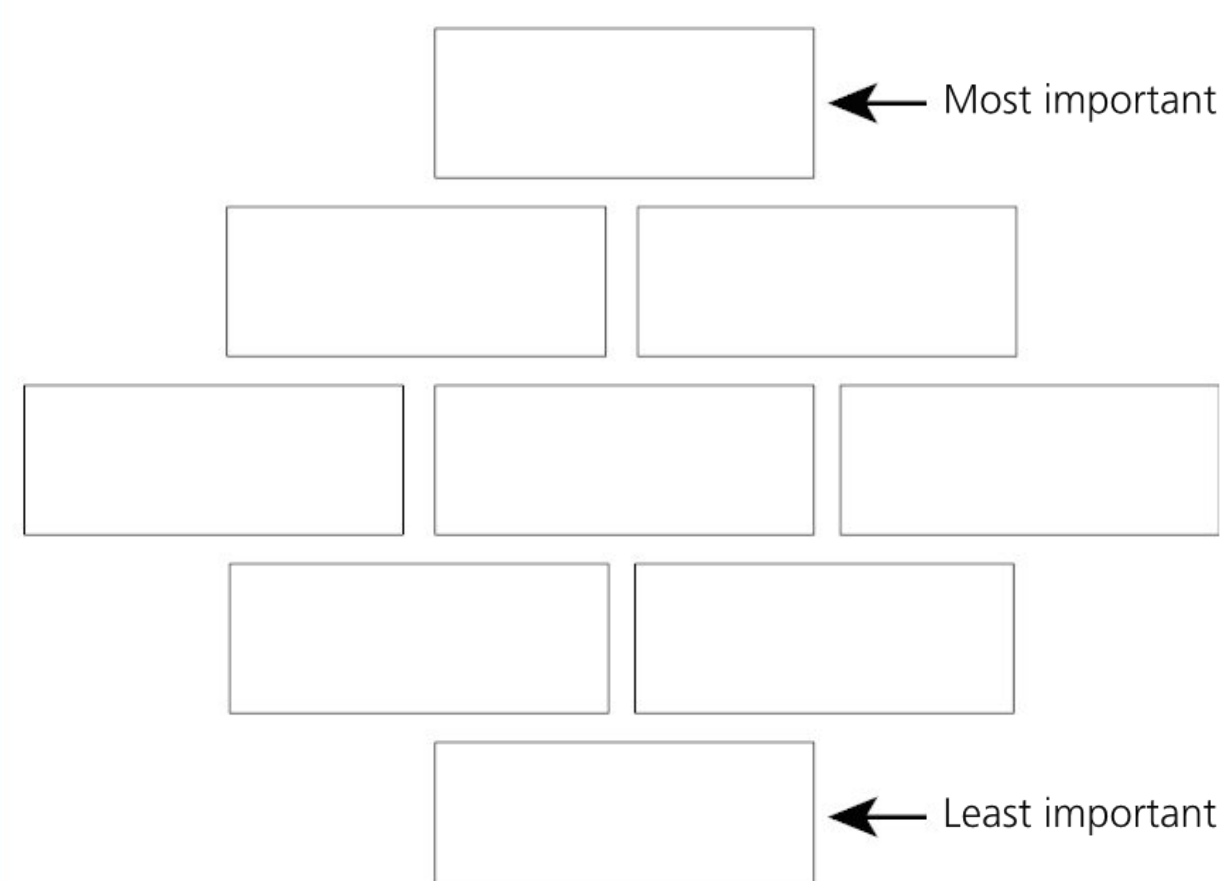
■ **Figure 10.4** Loss events worldwide, 2014

ACTIVITY: Defining a natural hazard

■ ATL

- Transfer skills: Combine knowledge, understanding and skills to create products or solutions

- 1 Search for the definition of **hazard** on: <https://en.oxforddictionaries.com/>
What is your definition of a natural hazard?
Discuss this with a partner.
- 2 Analyse Figure 10.4, which shows the global distribution of natural hazards that caused significant losses in 2014.
Create a mind map showing the reasons why natural events can cause losses.
- 3 In groups, **classify the reasons in order of importance.** You could use a diamond nine format (see Figure 10.5). **Discuss and debate the importance and significance of each factor. Try to come to a consensus.**



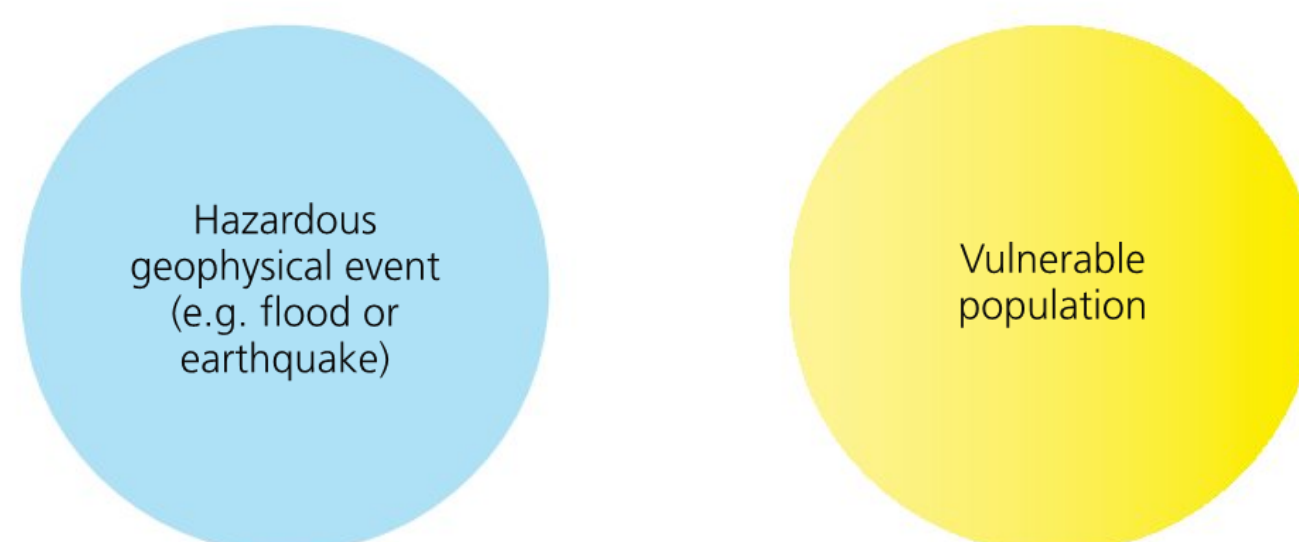
■ **Figure 10.5** A diamond nine organizer

◆ Assessment opportunities

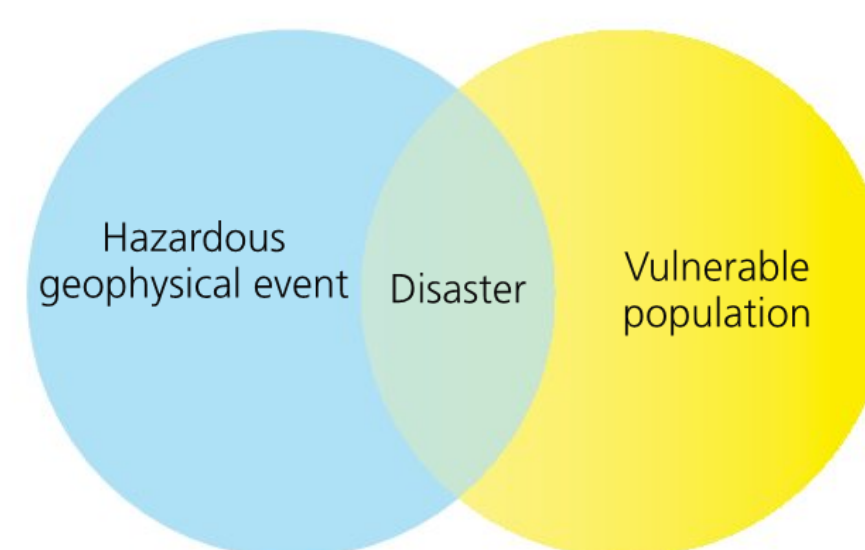
- ◆ This activity can be assessed using Criterion A: Knowing and understanding.

Natural hazards are extreme **geophysical processes** which can occur naturally in any part of the world. They include **tectonic processes**, such as earthquakes, volcanic eruptions, tsunamis; geomorphological processes, such as river and coastal flooding, landslides and avalanches; and atmospheric processes such as tropical cyclones, severe storms, tornadoes, wildfires and drought. These processes become hazardous when they have the potential to cause loss of life, damage to infrastructure and disruption to human activity. It is the potential impacts on people that transform naturally occurring processes into potentially life-threatening and destructive events. It is therefore the interaction between geophysical systems and human systems that characterize a hazard (see Figure 10.6).

No hazard or disaster



Disaster



■ **Figure 10.6** Degg's disaster model

Certain human activities can play a role in determining the severity and frequency of natural hazards. Rapid urbanization, as a result of population growth or migration, and pressures on land, due to modern farming practices, have all increased the exposure of populations to natural hazard risks in many parts of the world. (See page 232 for more on the causal link between **vulnerability** and risk.)

ACTIVITY: What is a natural disaster?

■ ATL

■ Information literacy skills: Make connections between various sources of information

Your goal is to assess the likelihood of a natural disaster occurring, using photographic interpretation (see page 7 for help).

Figure 10.7 shows examples of natural hazards and different levels of human vulnerability.

- 1 In pairs, brainstorm what you already know about the concepts of a natural hazard and human vulnerability.
- 2 Agree on a definition for natural hazards and human vulnerability.
- 3 For each photograph in Figure 10.7, identify whether the likelihood of a hazardous event occurring is high, and whether human vulnerability is high. Justify your decisions using photographic evidence.
- 4 Record your answers in a copy of Table 10.1.

- 5 Looking at those photographs where both the likelihood of a hazardous event and human vulnerability are high, suggest a new definition for disaster.
- 6 Suggest why is it difficult to define the concept of a disaster.

Photograph	Likelihood of a hazardous event occurring is high	Human vulnerability is high
(a)		
(b)		
(c)		
(d)		
(e)		

■ Table 10.1

◆ Assessment opportunities

◆ This activity can be assessed using Criterion A: Knowing and understanding.

WHAT ARE NATURAL DISASTERS?

As shown in Figure 10.6, a disaster can occur when a hazardous natural event gets closer to a **vulnerable population**. The more extreme the natural event is and the more vulnerable the population is, the more the two overlap and the more significant the disaster is. According to the International Federation of Red Cross and Red Crescent Societies, ‘a disaster is a sudden, calamitous event that seriously disrupts the functioning of a community or society and causes human, material, and economic or environmental losses that exceed the community’s or society’s ability to cope using its own resources. Though often caused by nature, disasters can have human origins’.

Defining a disaster is difficult and there are various indicators that can be used for doing so. Insurance companies usually attempt to compile estimates based on the monetary values of losses and set minimum loss boundaries for their compensation policies. A disaster can be also defined according to the **spatial** and **temporal** components of specific events. The United Nations uses Sustainable Development Goal indicators based on the scale of disaster events. According to the UN, a small-scale disaster is a type of disaster affecting a local community which only requires

assistance from the neighbouring communities, whereas a large-scale disaster is a disaster affecting a society which requires national or international assistance. However, time is in most cases the most crucial element during any disaster event and, according to the 2017 United Nations report, Terminology on Disaster Risk Reduction, disasters can be classified against three different timescales:

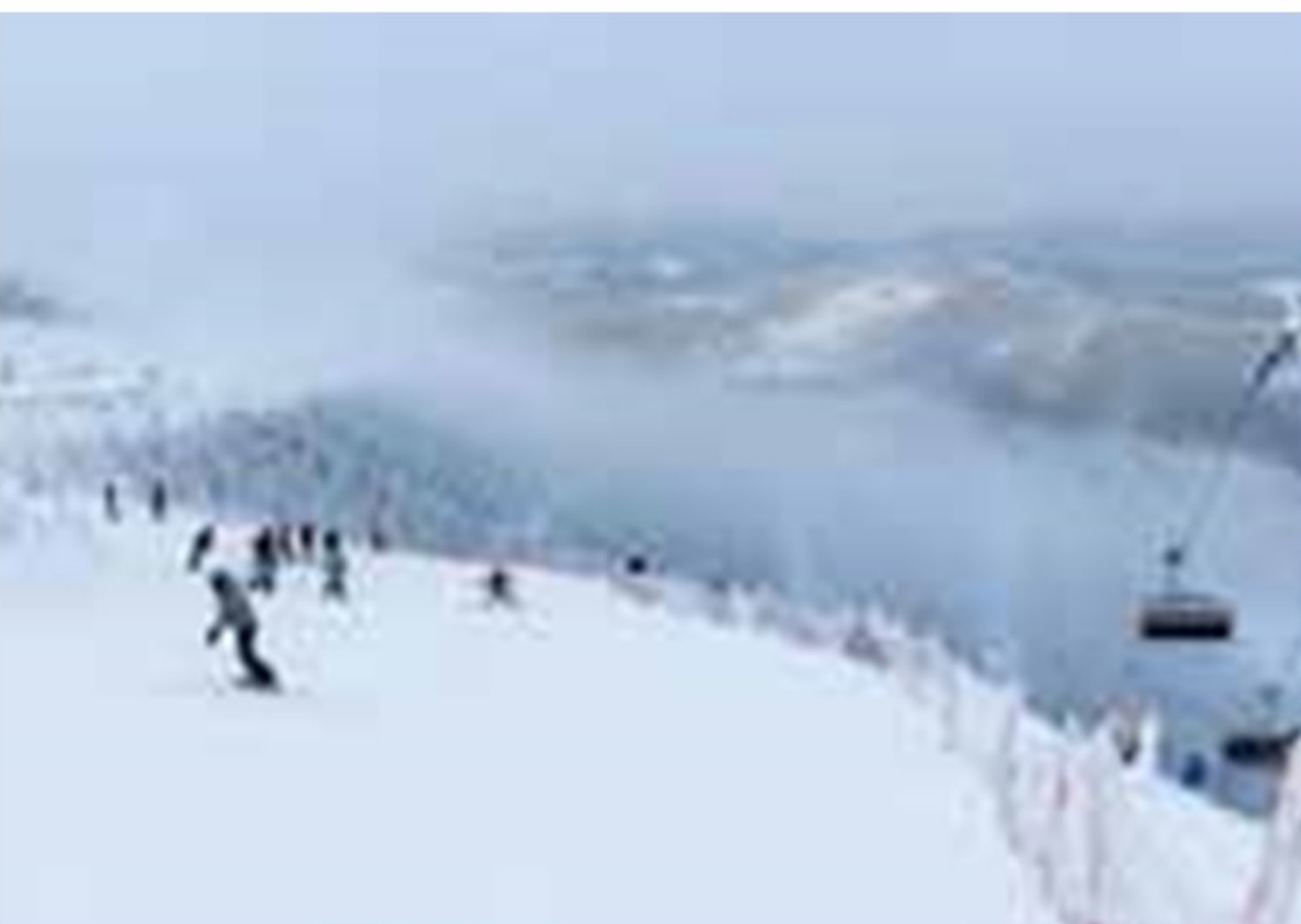
*‘Frequent and infrequent disasters depend on the probability of occurrence and the **return period** of a given hazard and its impacts. The impact of frequent disasters could be cumulative, or become chronic for a community or a society. A slow-onset disaster is defined as one that emerges gradually over time. Slow-onset disasters could be associated with, e.g., drought, desertification, sea-level rise, epidemic disease. A sudden-onset disaster is one triggered by a hazardous event that emerges quickly or unexpectedly. Sudden-onset disasters could be associated with, e.g., earthquake, volcanic eruption, flash flood, chemical explosion, critical infrastructure failure, transport accident.’ – United Nations report, Terminology on Disaster Risk Reduction*



■ **Figure 10.7 (a)** Mount Vesuvius in the Bay of Naples, Italy



■ **Figure 10.7 (b)** Ash clouds from the 2010 Eyjafjallajökull eruption in Iceland



■ **Figure 10.7 (c)** Skiers on Mount Skrzyczne in Poland



■ **Figure 10.7 (d)** A swollen River Seine during the Paris flood of 2018



■ **Figure 10.7 (e)** Favela Morro dos Prazeres in Rio de Janeiro, Brazil

DISCUSS

'Hazards may be natural, but disasters are not.'

In pairs, **discuss** this statement.

What is the global trend in natural disasters?

ACTIVITY: Global trends in natural disasters

■ ATL

- Critical-thinking skills: Practise observing carefully in order to recognize problems

For this task, you need to use Figure 10.4 on page 220 and Figure 10.8 below.

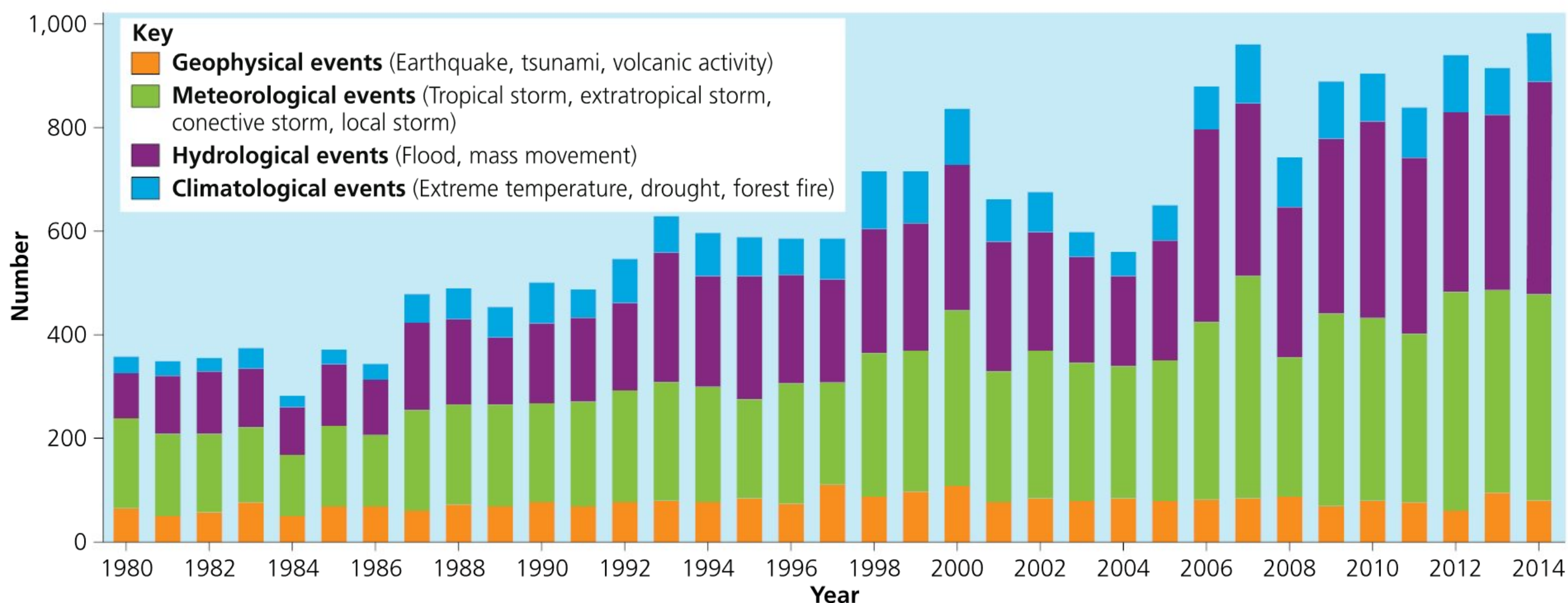
You are going to use the TEA technique to help you complete a spatial and temporal analysis of the global trends in natural hazards since the 1980s. (Refer to page 12 for help on how to use the TEA technique.)

- 1 **Analyse** the map in Figure 10.4. **Describe** the pattern of global loss events in 2014.
- 2 **Analyse** the graph in Figure 10.8. **Describe** the changes in loss events from 1980 to 2014.

- 3 **Explain** the trend described in Question 2. **Justify** your answer with reference to your own knowledge and information from Chapters 4, 9 and 11.
- 4 **Investigate** some of the anomalous loss events from Figure 10.8 (1980 to 2014). **Find** which major natural disasters have caused some of highest losses.
- 5 Using Figure 10.4, decide which hazards caused the most human and economic losses. Use evidence to support your points.
- 6 Using Figure 10.4, decide which regions have suffered the most human and economic losses. Use evidence to support your points.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.



■ **Figure 10.8** Loss events worldwide, 1980–2014

The global distribution of natural disasters causing significant losses, as shown in Figure 10.4, illustrates how varied the range of hazards can be in different places. (We will analyse the unequal distribution of the impacts between developing and developed countries on page 232.) The number of loss events from natural disasters has shown an overall upward trend since the 1980s. The distribution of event types has also evolved, with meteorological and hydrological events more than doubling over the past 40 years, in contrast with geophysical events which remained stable over the same period. The overall growth in impacts is in part due to the fact that more people are exposed to natural hazards and therefore at risk than in previous decades. This can be mainly explained by rapid population growth, especially in cities, with 55 per cent of the world population living in urban areas by 2018. Other factors such as economic growth, increased vulnerability of certain populations, land pressure and political instability can also contribute to this trend. The effects of globalization can also play a part, with the number of reported disasters increasing due to improvements in communication systems.

ACTIVITY

■ ATL

■ Critical-thinking skills: Evaluate evidence and arguments

Discuss in pairs how the following factors would increase the likelihood of a natural hazard causing significant losses. Record your ideas in a copy of Table 10.2.

Factor	How it would increase the likelihood of a natural hazard causing significant losses
Household income	
Population density	
Illiteracy rate	
Population structure	
Percentage of dependent population	

■ **Table 10.2** Effect of factors on the likelihood of a natural hazard causing significant losses

◆ Assessment opportunities

◆ In this activity you have practised skills that are assessed using Criterion D: Thinking critically.

How do natural hazards change in scale, magnitude and frequency?

THE ODD ONE OUT

Working with a partner, study the sets of words in Table 10.3. Decide which word from each set is the odd one out. Be prepared to **justify** your choice to the rest of the class.

Set	Which is the odd one out?
A	earthquake – landslide – volcano – tsunami
B	flooding – avalanche – landslide – snowstorm
C	subsidence – hurricane – tornado – drought
D	disease – insect plague – lightning – wildfire

■ **Table 10.3** Odd one out

Give each set of the remaining words a category name. You may want to use page 220 to help you.

WHAT ARE THE MAIN TYPES OF HAZARDS?

Hazards can be classified according to a range of criteria. Geographers organize them according to geophysical processes, but hazards can also be divided according to magnitude, frequency, geographical location and scale. The physical processes and physical properties of the Earth’s diverse environments produce unique groups of hazards with distinct key characteristics. For example, tectonic processes result in the most dramatic and most devastating hazardous events, such as volcanic eruptions and tsunamis. Hydrological processes are not only responsible for river flooding but also for mudflows. The boundaries between different types of hazards can become blurred when one hazard event triggers another set of hazards in another geophysical system. For example, an earthquake can trigger a landslide in a natural environment but also result in widespread fires in urban environments. Some hazards can result from the combination of several geophysical processes, such as in the case of flood hazards due to river and coastal flooding.



■ **Figure 10.9** Natural hazards



ACTIVITY: A classification of hazards

ATL

- Information literacy skills: Access information to be informed and inform others

Search online for the definitions of the following geophysical processes:

- Tectonic
- Atmospheric
- Geomorphological
- Biological

Now **identify** the different types of natural hazards based on the geophysical processes you described above by **analysing** the photos in Figure 10.9. Make sure you accurately **state** the evidence you are referring to (see page 7 for help on how to describe photographs) and record this in a copy of Table 10.4.

Photo	Type of geophysical process	Hazard photo evidence
(a)		
(b)		
(c)		
(d)		
(e)		
(f)		
(g)		
(h)		
(i)		

Table 10.4 Natural hazards and types of geophysical process

Assessment opportunities

- This activity can be assessed using Criterion D: Thinking critically.

ACTIVITY: Origin and purpose

■ ATL

- Critical-thinking skills: Gather and organize relevant information to formulate an argument; Recognize unstated assumptions and bias; Evaluate evidence and arguments; Consider ideas from multiple perspectives

- 1 Read Sources A, B and C below and identify four causes and four effects from the hazard events described. Record your findings in a copy of Table 10.5.

Causes	
1	
2	
3	
4	
Effects	
2	
3	
4	

■ Table 10.5 Causes and effects of hazard events

- 2 Outline the origin, purpose, values and limitations of Sources A to C in a copy of Table 10.6. (Refer back to Chapter 1, page 16 for guidance on how to do an OPVL source analysis.)

Source	Origin	Purpose	Values	Limitations
A				
B				
C				

■ Table 10.6 OPVL analysis

- 3 Classify the causes listed in Question 1 into physical and human causes.
- 4 Compare Sources A, B and C in terms of their impact (social, economic, environmental and political). (Refer to Figure 1.44 on page 26 for how to use the SEEP structure.)
- 5 From the evidence from your OPVL analysis and your answers to the questions above, would you describe these hazards as natural or human induced? Justify your answer.

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion D: Thinking critically.

SOURCE A

Description and impacts of the Mumbai monsoon flood of July 2005

The unprecedented rainfall in Mumbai resulted in a near complete inundation of the city as flood waters rose to engulf the first floor of most buildings. The population exposed to this natural disaster was about 13 million, with a density of about 28,000 persons per square kilometer. Both flash flooding and river flooding contributed to the damage. Drainage infrastructure was incapable of accommodating the volume of runoff water resulting in failure of the sanitary sewer system. The Mithi and other rivers overflowed as discharge exceeded capacity. The resulting floods cut off rail and road systems. Residents reported having to spend the night stranded in cars or wading home through the high water. More than 100,000 residential and commercial buildings reported damage, along with 30,000 vehicles (Gupta, 2007).

Bhagat et al. (2006) examined the flood from an urban planning perspective and concluded that land-use decisions and a lack of coordinated planning were responsible for the flooding. Of the six major natural drainage systems of the area, four of them are over 40 percent built up. The rivers themselves are often clogged with garbage due to inadequate waste management. Open gutters in the suburban area of Mumbai carry both storm water and sewage. After the flood these became slow-draining cesspools which contributed to the disease outbreak. Government agencies with legislatively mandated responsibilities share planning authority but lack effective coordination. Thus India’s most populous city has no integrated urban planning system and agencies are free to blame other agencies after a disaster.

Taken from www.researchgate.net

SOURCE B

Japan: fatal avalanche engulfs skiers after volcano erupts

A member of Japan's self-defence forces died and about a dozen skiers were injured after a volcano erupted near a ski resort, triggering an avalanche and sending rocks raining down on the slopes.

The skiers were injured when they became trapped by the avalanche or were hit by falling volcanic rocks from Mount Kusatsu-Shirane, according to local media. Five were seriously injured, but none was in a critical condition, rescuers said.

Three other people caught in the avalanche were also rescued, Japanese media said on Tuesday. Among the injured were four people hurt by shattered glass while on a gondola at the resort in Gunma, north-west of Tokyo. About 100 people were evacuated from the area.

'There was this huge boom, and a big plume of totally black smoke rose up,' one skier told NHK [Japanese broadcasting organization]. 'I had absolutely no idea what had happened.'

Kusatsu-Shirane, a 2,160-metre (7,090ft) volcano, appeared to have erupted on Tuesday morning, the Japanese meteorological agency (JMA) said.

The disaster agency warned that rocks could be thrown as far as 2km (1 mile) from the peak. Makoto Saito, an agency official, said there was a risk of further avalanches.

It was unclear whether the avalanche was caused by the volcanic activity, but they occurred nearly simultaneously.

'Based on various measurements, we can say that the mountain appears to have erupted, but we are still trying to confirm facts on the ground,' a JMA official said.

'It's very difficult to predict smaller eruptions such as the one that occurred today,' said Yasuto Kuwahara, director of the Research Institute of Earthquake and Volcano Geology at the National Institute of Advanced Industrial Science and Technology.

Kuwahara said it was not yet clear if the eruption had been caused by the interaction of magma or lava with water, or if it had been a phreatic eruption, which occurs when magma heats ground or surface water.

'There are many phenomena that precede a huge earthquake or volcanic eruption,' he said. 'We are able to identify some of the precursors, but there will always be cases when eruptions happen very abruptly. That was the case this morning. It would have been very difficult to predict and order an evacuation.'

From the Guardian, 23 January 2018

SOURCE C

UK: Personal Experience of Flooding

Tim Aston lives in Newton, Tewkesbury, in Gloucestershire. His house is not on the Environment Agency's floodplain map – something he had checked before the flooding. Tim described the torrential rain that fell all day on Friday 20 July as unbelievable and unlike anything he had experienced previously.

'It was like it was the end of the world.'

As a photographer, Tim was at a wedding that Friday and by the time he had left the reception at around 10pm, the water level in places was up to his waist as he waded against a strong current to get home. Tim's house had not yet been affected by the floods when he returned as it was on higher ground, and he believed he would be safe as the rain had started to ease off.

After reaching home, Tim noticed a patch of water on the floor near the patio doors and within a minute, the downstairs carpet was floating in an inch of water. Tim grabbed a number of essential items, while his wife turned off the power before the water reached the sockets. By the time he had returned downstairs for a second load of belongings, the water was shin-deep and much of what had been downstairs, including many precious personal items, was destroyed. Tim's neighbour called to tell him to move his car to higher ground, but unfortunately it was too late as both the car and his motorbike were flooded. While talking to his neighbour, Tim was able to look at his surroundings and it was only then that the enormity of the event struck him.

'Water was everywhere and it'd all happened within a couple of hours.'

The water levels started to recede at around 9am on Saturday and most of the water was out of the house by midday. However, by that evening, Tim noticed a perceptible rise in the water levels again and by Sunday morning, it was rising at a rate of around 1 inch per hour. 'The worrying thing was that we just didn't know when it was going to stop rising.' It took until Monday morning for the water levels to become static and until late Monday afternoon for it to recede, leaving Tim and his family with the inevitable but distressing job of starting the clean-up. Although the whole event was a devastating experience for Tim and his family, he believed that there were a number of positives. Community spirit in his area improved and the experience encouraged Tim to look differently at the priorities in his life.

'It was a life changing experience.'

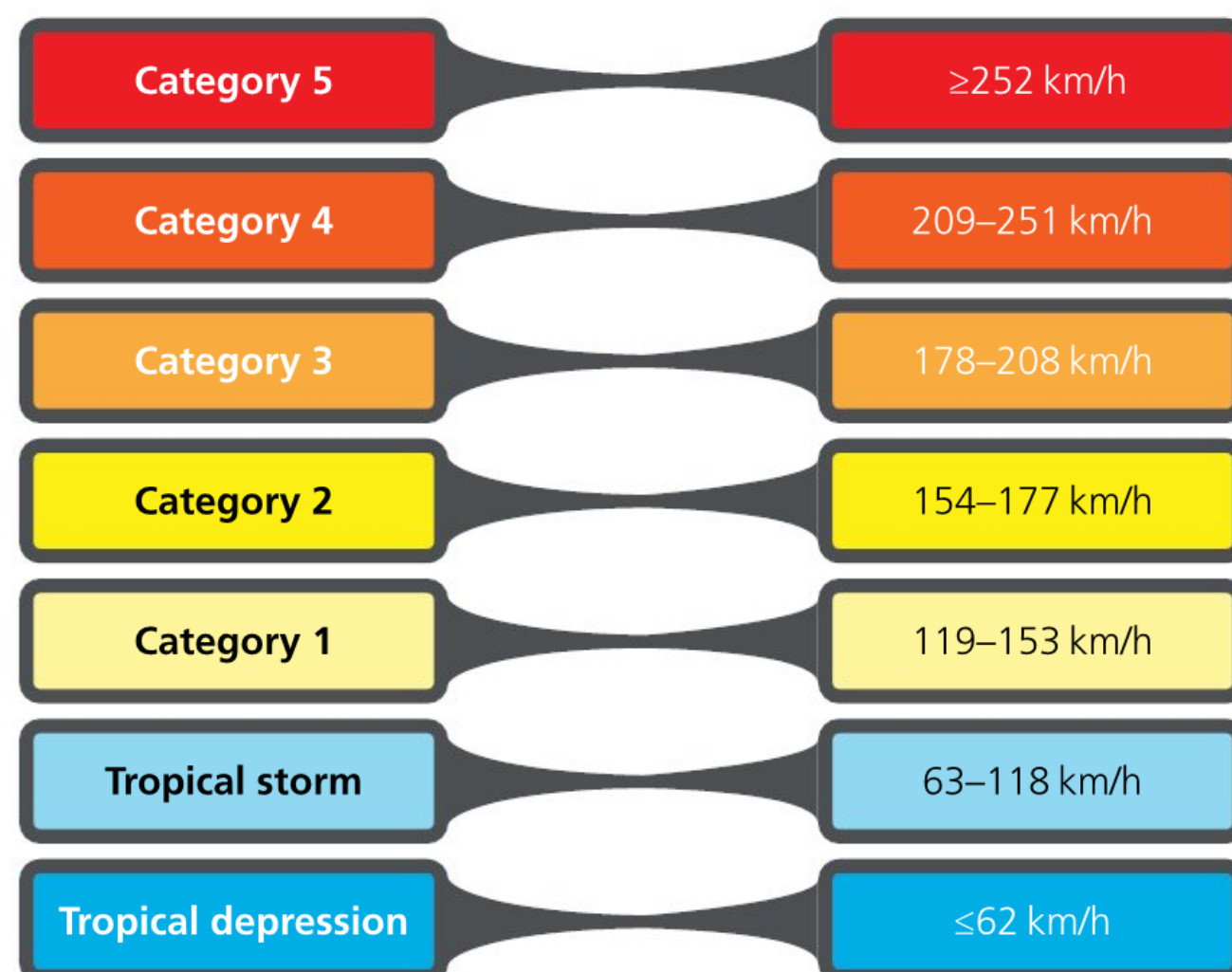
Extract from the Pitt Review, December 2007

MAGNITUDE AND FREQUENCY OF HAZARDS

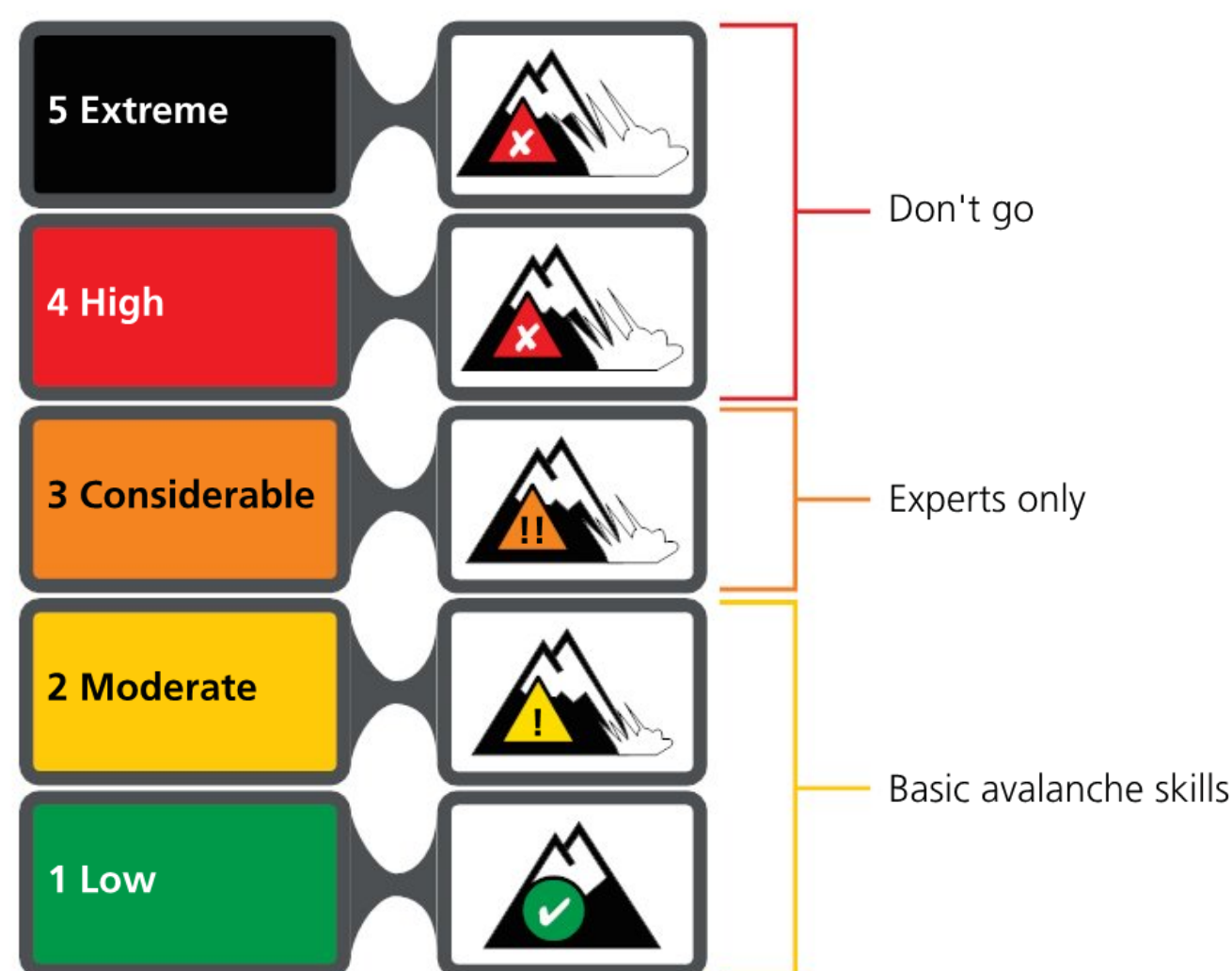
Magnitude refers to the size of a geophysical hazard event and is measured by the amount of energy or the amount of material produced by the event. For example, the magnitude of an earthquake is measured by the amount of energy released when two of the Earth's plates move past each other, whereas for an avalanche it is the speed, volume and density of snow that are measured. Natural hazard events are measured against specific scales, some of which are well known to the general public, such as the Richter scale for earthquakes (see page 254 in Chapter 11). Other scales are widely used by scientists such as the Volcano Explosivity Index which helps volcanologists predict the potential size of volcanic eruptions. Magnitude scales are also used by authorities and emergency rescue teams when preparing to respond to an event, such as the Saffir–Simpson scale for hurricanes (see Figure 10.10) or dealing with the immediate aftermath of an event, such as the European Avalanche Danger Scale (see Figure 10.11).

Frequency refers to the number of hazardous events of a certain magnitude that occur over a given period of time. Natural hazards may be constantly present or be subject to fluctuations. Some hazards are periodic, meaning that they happen at regular intervals. This is the case with earthquakes that occur in almost predictable time periods because of the build-up of strain along faults. Other types of hazards, such as geomorphological or atmospheric ones, are more seasonal. Some events, such as lightning or fires, are random.

There is an important relationship between the frequency and size of hazard events. Statistical studies have revealed that larger events tend to be less frequent than smaller events. The 'return period' is the term used in estimates



■ **Figure 10.10** The Saffir–Simpson scale



■ **Figure 10.11** The European Avalanche Danger Scale

of the likelihood of when an event is going to occur. Statistical analysis of the frequency of events is often used to determine the probability of the occurrence of events of a certain size. The probability of occurrence is used widely by the media when reporting on natural disasters. For example, news reports often refer to the term '100-year flood', meaning that statistically a large flood has a 1 per cent chance of occurring in any given year (see Table 10.7).

Recurrence interval, in years	Probability of occurrence in any given year	Percentage chance of occurrence in any given year
100	1 in 100	1
50	1 in 50	2
25	1 in 25	4
10	1 in 10	10
5	1 in 5	20
2	1 in 2	50

Table 10.7 Recurrence intervals and probabilities of occurrences, from the United States Geological Survey

Links to: Mathematics

Explore the ways in which mathematicians model the different outcomes of chance events using probability distributions such as the Poisson or Binomial distributions. (See *MYP Mathematics by Concept 4&5* for more information!)

ACTIVITY: Magnitude and frequency

ATL

- Critical-thinking skills: Interpret data
- Communication skills: Use and interpret a range of discipline-specific terms and symbols

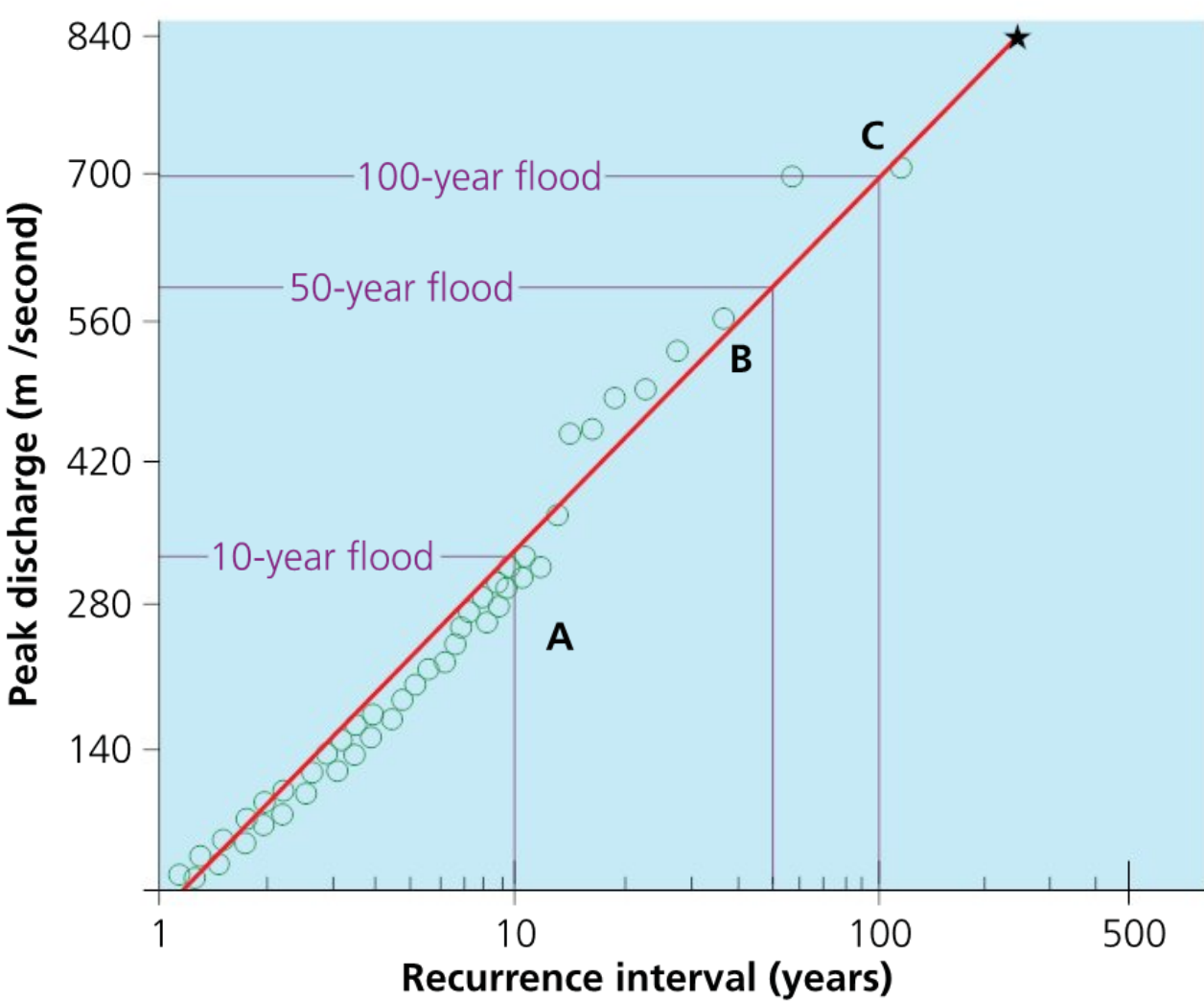


Figure 10.12 Peak discharge vs recurrence interval

- 1 Interpret the scatter graph in Figure 10.12, which shows flood recurrence intervals against magnitude (peak discharge), by exploring flood events of:**
 - low magnitude and high frequency (A)
 - medium to high magnitude with medium to low frequency (B)
 - high to very high magnitude with rare occurrence (C).

Search online for **10-year flood**, **50-year flood**, **100-year flood** and **500-year flood**. Look at news articles on flood events to help you explore the different flood return periods A, B and C. Also use Source D (below) to help you.

- 2 Working in pairs, discuss the following questions:**
 - 'A flood return period (10-year, 50-year, 100-year flood and so on) is more an indication of the scale of an event than its likelihood.' How far do you agree with this statement? **Justify** your views with evidence from the examples you researched in Question 1.
 - **To what extent** are more frequent 500-year floods a reason for revising recurrence intervals of floods? Would more recorded flood data of extreme events change the probability of high magnitude floods occurring? **Discuss** with reference to the examples you researched in Question 1 and Figure 10.12.

SOURCE D

'In theory, a 500-year flood is something that has a 1-in-500 shot of happening in any given year – in other words, the sort of event that's so rare that it might not make sense to plan around the possibility of it happening. The problem is that 500-year floods are happening more often than probability predicts – especially in Houston. And, especially in Houston, prevention planning hasn't evolved to acknowledge that a '500-year' flood isn't really a 1-in-500 chance anymore.'

From *www.vox.com*, 22 September 2018

Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowledge and understanding and Criterion D: Thinking critically.

Why are some places more vulnerable than others?

HAZARD PERCEPTION, VULNERABILITY AND RISK

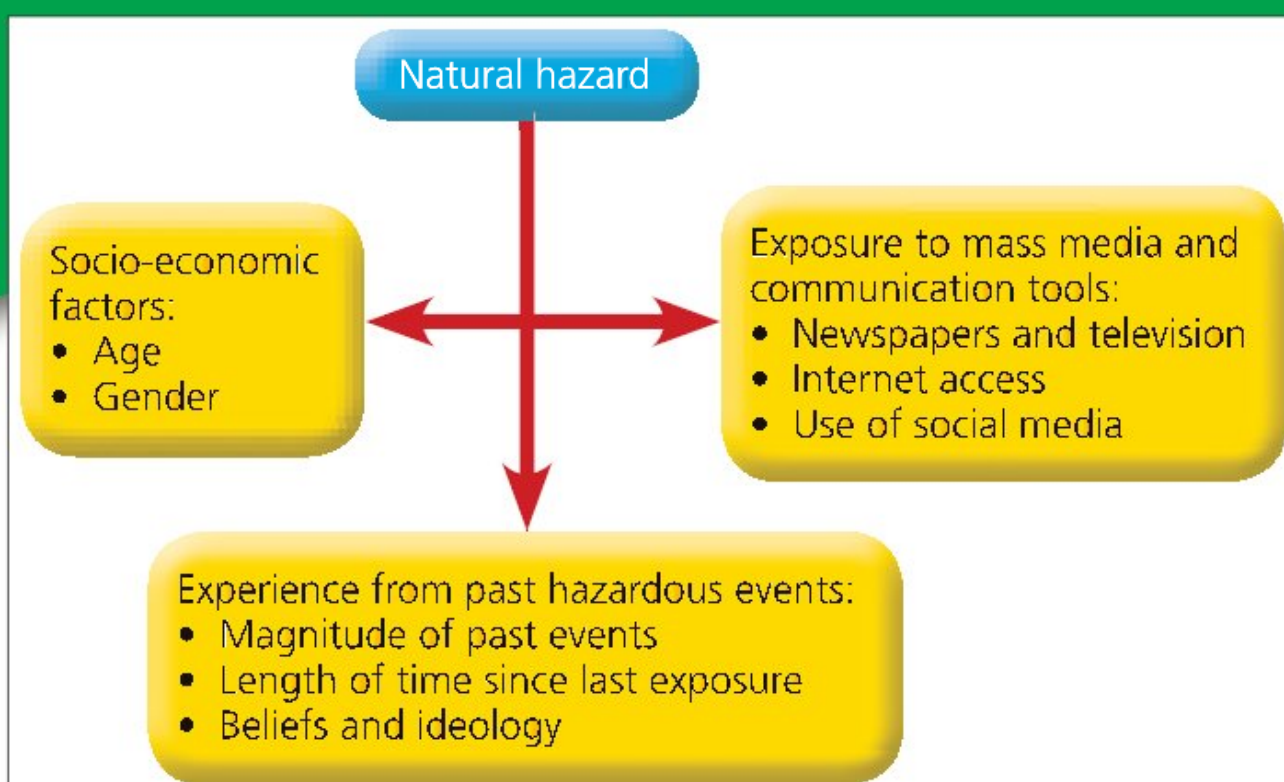
DISCUSS

To what extent are the people in Figure 10.13 vulnerable following the floods in Bangladesh in the summer of 2007? **Discuss** in pairs.



■ **Figure 10.13** Flood victims in Bangladesh

We have seen earlier in this chapter that natural events can pose a risk when the hazard from natural processes affects populations (see Figure 10.6 on page 221). However, we are also exposed to potential hazards in our everyday activities as we travel to school or a workplace, or when we take part in leisure and sporting activities in unfamiliar environments at the sea, by rivers or in mountains. We are therefore all potentially at risk of being affected by a range of everyday hazards. People perceive risks when there is a threat to their lives but are often less aware of risks to their assets, such as properties or vehicles. People may also be more at risk because of different degrees of hazard perception.



■ **Figure 10.14** Hazard perception model

Some factors may be more influential than others in people's perception of risk and therefore their ability to prepare for and respond to the threat from natural hazards. Scientific studies have shown that experience of past hazardous events may contribute to a more accurate perception of risks than other factors such as age, occupation and educational attainment (see Figure 10.14).

ACTIVITY: Hazard perception

■ ATL

- Information literacy skills: Make connections between various sources of information
- Reflection skills: Consider content

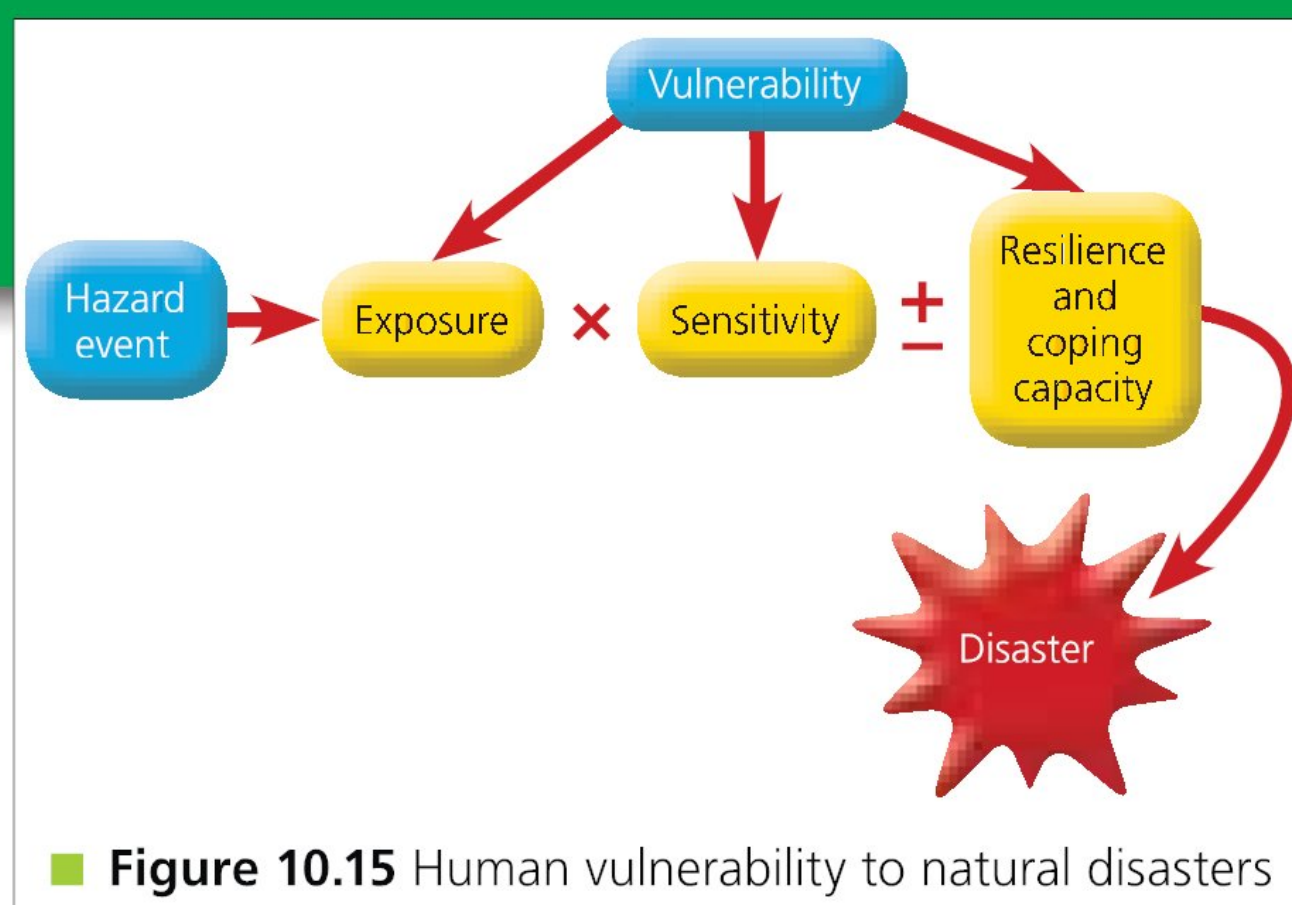
Using the knowledge you have gained on the concept of hazard perception, find a range of photographs that illustrate the following statements:

- **Natural hazards are natural events that are part of normal life or that result from an act of God.**
- **Natural hazards are extreme events that can be controlled through the use of technology.**
- **Natural hazards result from a range of physical and human processes. Humans need to adapt to and find flexible approaches to these hazards.**

Share your findings with a partner and **justify** your choices with reference to photographic evidence (see page 7 for more on describing photographs).

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding.



Over the period from 2006 to 2015, there were nearly 70,000 deaths per year from natural disasters globally. Despite this, people continue to live in hazardous places for various complex reasons. Exposure to the risk from disasters is not equal across the globe and can vary in scale from one country to another because of different levels of vulnerability. Human vulnerability can be defined as the degree to which people are susceptible to loss, damage, suffering and death, in the event of a disaster (see Figure 10.15). It depends on a range of factors:

- **Exposure:** the nature of the area in which people live – how hazardous it is
- **Sensitivity:** some groups of people are more at risk than others, for instance the elderly or infants
- **Resilience:** the ability of individuals and societies to cope with the sudden impact of disasters, and to restore as quickly as possible their ability to function
- **Coping capacity:** the resources available to individuals and societies to cope with a threat or resist the impact of a disaster

The vulnerability in developing countries tends to be higher than in developed countries, mainly because of a reduced coping capacity. Poorer nations often see high rates of internal migration with new migrants settling in slums, unaware of the hazards in their new environment. Local authorities in some poorer countries do not prioritize hazard educational and awareness campaigns because of a lack of effective governance or funding. Medium- to long-term responses to hazard events are often not appropriate due to a shortfall in investment in early warning systems or scientific monitoring programmes. Short-term emergency response is also hampered by a shortage of trained personnel.

ACTIVITY: The world at risk

■ ATL

- Critical-thinking skills: Practise observing carefully in order to recognize problems

Explore the maps in Figures 10.16 to 10.18 (pages 234–36) which represent global hazards and exposure, global vulnerability and global lack of coping capacity.

- 1 **Describe** each map using the TEA technique (see page 12).
- 2 **Evaluate by comparing and contrasting** the maps of hazard exposure and coping capacity.
- 3 **Evaluate by comparing and contrasting** the maps of vulnerability and coping capacity.
- 4 **Explain** the main trends you have observed and **suggest** reasons for anomalies.
- 5 **To what extent** do your observations relate to differences in levels of development? **Justify** your views.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.

DISCUSS

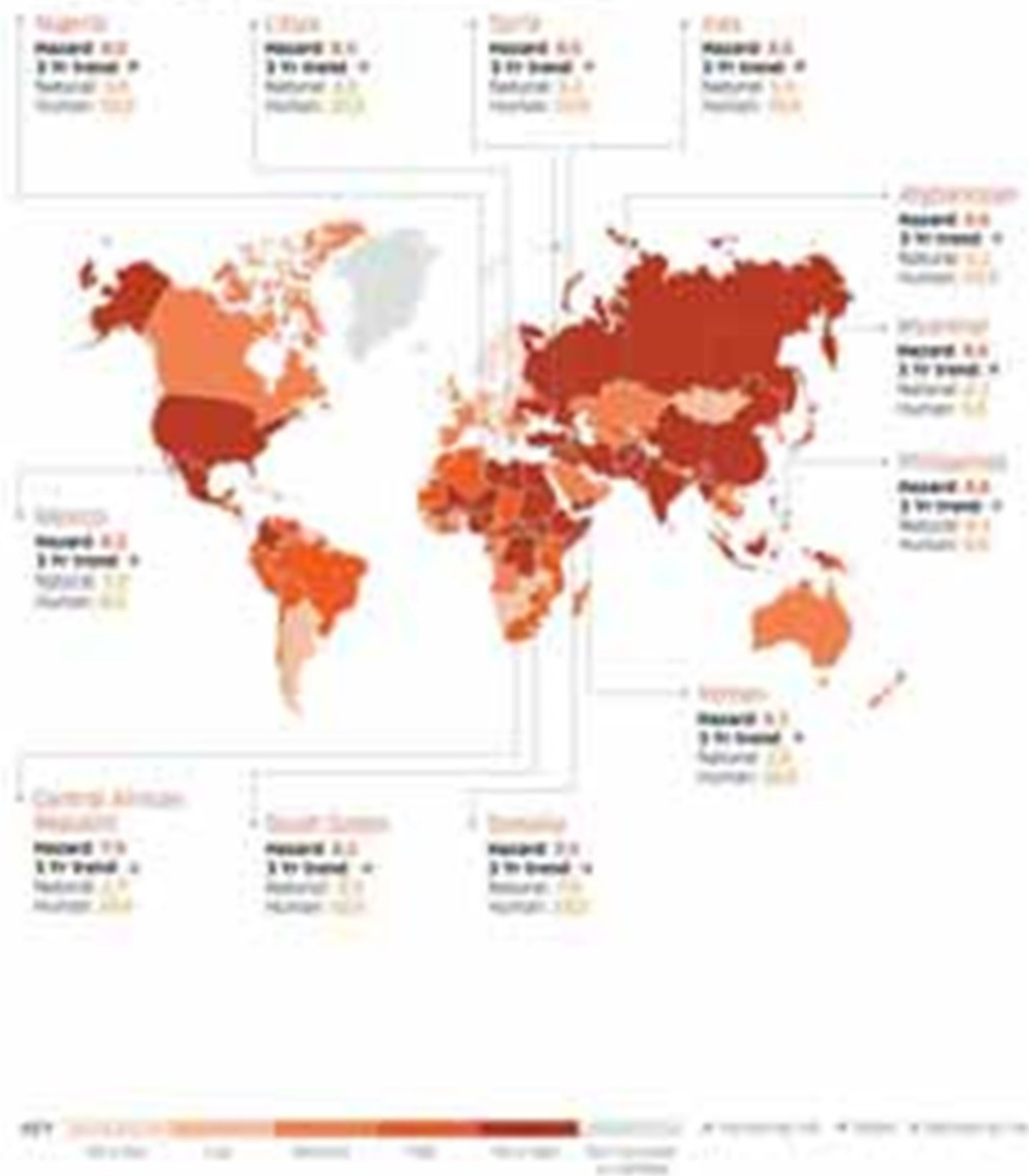
The Human Development Index is a measure of disparities between nations, which combines three variables:

- Life expectancy
- Educational attainment
- Income per person

This index correlates with the impact of natural disasters. Is this a fact of life we should accept?

Discuss as a class.

INFORM QRI 2019 Hazard and exposure dimension



■ **Figure 10.16** Global hazards and exposure



■ **Figure 10.17** Global vulnerability

INFORM GRI 2019 Lack of coping capacity dimension



■ **Figure 10.18** Global lack of coping capacity

ACTIVITY: Using GIS to map the vulnerability of the world's most populated regions

■ ATL

- Information literacy skills: Understand and use technology systems
- Critical-thinking skills: Use models and simulations to explore complex systems and issues

You are going to use ArcGIS Online to help you **investigate** the global distribution of tectonic and atmospheric hazards in relation to the most populated regions.

Open a new ArcGIS Online map and search for four map layers using the following layer titles:

- Earthquakes Magnitude 5.7+
- Cyclones intensity
- World population density
- Earth's Tectonic Plates

Once these are added to your ArcGIS Online map, your map content panel should look like Figure 10.19.



■ **Figure 10.19** Map content panel

Refer back to page 19 if you need to learn how to add layers on ArcGIS Online and change the base map.

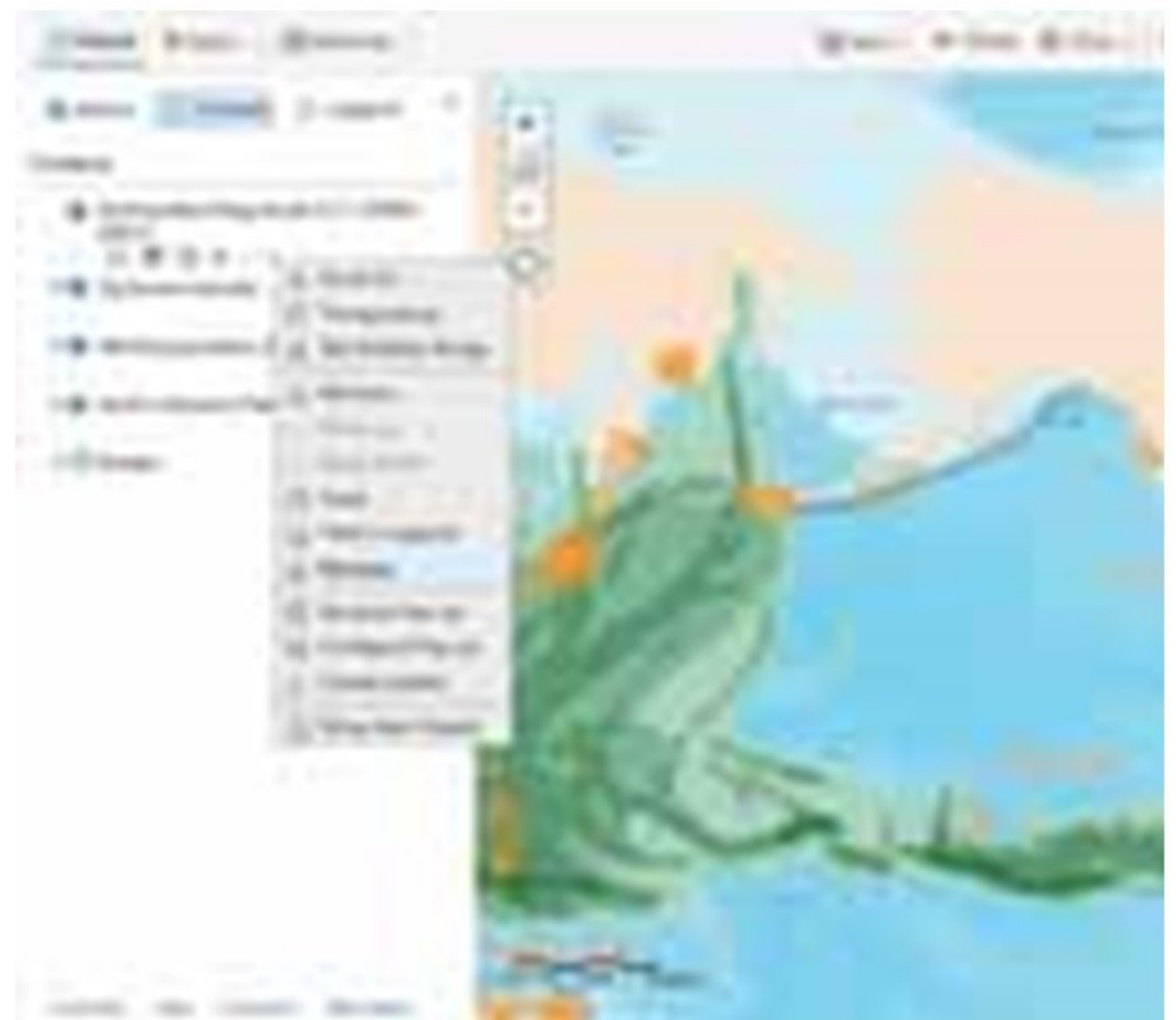
Your map should then look like Figure 10.20.



■ **Figure 10.20** Map

Use the four layers and simple GIS tools, such as *Turning layers on and off* and the *Transparency* tool (see Figure 10.21) to help you **identify** the:

- **most hazardous world regions**
- **megacities** with the largest range of natural hazards.



■ **Figure 10.21** Layer transparency

Evaluate the extent to which multiple-hazard-prone cities are mainly located in developing regions.

Summarize the strengths and weaknesses of the map evidence before reaching a conclusion.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.

ACTIVITY: Vulnerability case studies

■ ATL

- Information literacy skills: Access information to be informed and inform others
- Communication skills: Structure information in summaries, essays and reports

Explore this GIS Storymap to discover the world exposure to natural disasters: <https://arcg.is/1LrGKq>

Working in Groups A and B, and referring to the definitions of the different components of vulnerability on page 233, **investigate** the vulnerability of the population in:

- Switzerland (Group A)
- Bangladesh (Group B).

Make notes on your respective case studies in a copy of Table 10.8.

	Switzerland	Bangladesh
Hazards		
Exposure		
Sensitivity		
Resilience		
Coping capacities		

■ **Table 10.8**

Collate the research from the other group into your table.

Discuss as a class the factors affecting the levels of vulnerability in the two countries you have **investigated**

Write a short essay entitled: **Compare and contrast** vulnerability levels between two contrasting case studies.

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion B: Investigating, Criterion C: Communicating and Criterion D: Thinking critically.

ACTIVITY: What is the relationship between earthquake magnitude and number of fatalities?

■ ATL

- Critical-thinking skills: Identify trends and forecast possibilities; Interpret data; Test generalizations and conclusions

You are going to use scatter graphs to **investigate** the relationship between earthquake magnitudes and the number of fatalities.

- 1 Visit this website, which shows the deadliest earthquakes since 1988:
www.abc.net.au/news/2015-10-27/deadliest-earthquakes-in-the-asia-pacific-region/6788452
- 2 Compile the information about the magnitude, fatalities, year and location into a copy of Table 10.9.

Year	Magnitude	Fatalities	Location
1988	6.8	721	Nepal

■ **Table 10.9** Deadliest earthquakes since 1988

- 3 **Create** a scatter graph, either on paper or using a spreadsheet on a computer, to **show** the relationship between magnitude and number of fatalities. **Plot** the data from Table 10.9 on your graph.
- 4 **Analyse** your graph with reference to the strength of the correlation, line of best fit and outliers. Refer back to page 13 if you need a reminder of how to **analyse** graphs.
- 5 **Interpret** the significance of the correlation shown by your graph. What does it **suggest** about the relationship between magnitude and number of fatalities? What can you **deduce**?
- 6 **Identify** other factors, other than magnitude, that could affect how hazardous earthquakes are. You could use a mind map to classify your ideas into physical and human factors.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding, Criterion B: Investigating and Criterion D: Thinking critically.

ACTIVITY: Comparing avalanches in contrasting locations

■ ATL

- Information literacy skills: Make connections between various sources of information

- 1 Research information to put together a case study of an avalanche. You could choose your own example from an area you have already learnt about or from your home country. You could also visit this website to **explore** examples of avalanche events:
www.theguardian.com/world/avalanches
- 2 **Analyse** the impacts of your chosen avalanche event. You could use the SEEP structure (social, economic, environmental, political – see Figure 1.44 on page 26) to help you categorize the impacts.
- 3 Feed back to a partner who has researched a different example: What are the similarities and differences between your examples? Could either of your examples be **classified** as a disaster? If not, can you think of circumstances when an avalanche might be seen as a disaster?

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding and Criterion D: Thinking critically.

Is it ever possible to be completely prepared for natural disasters?

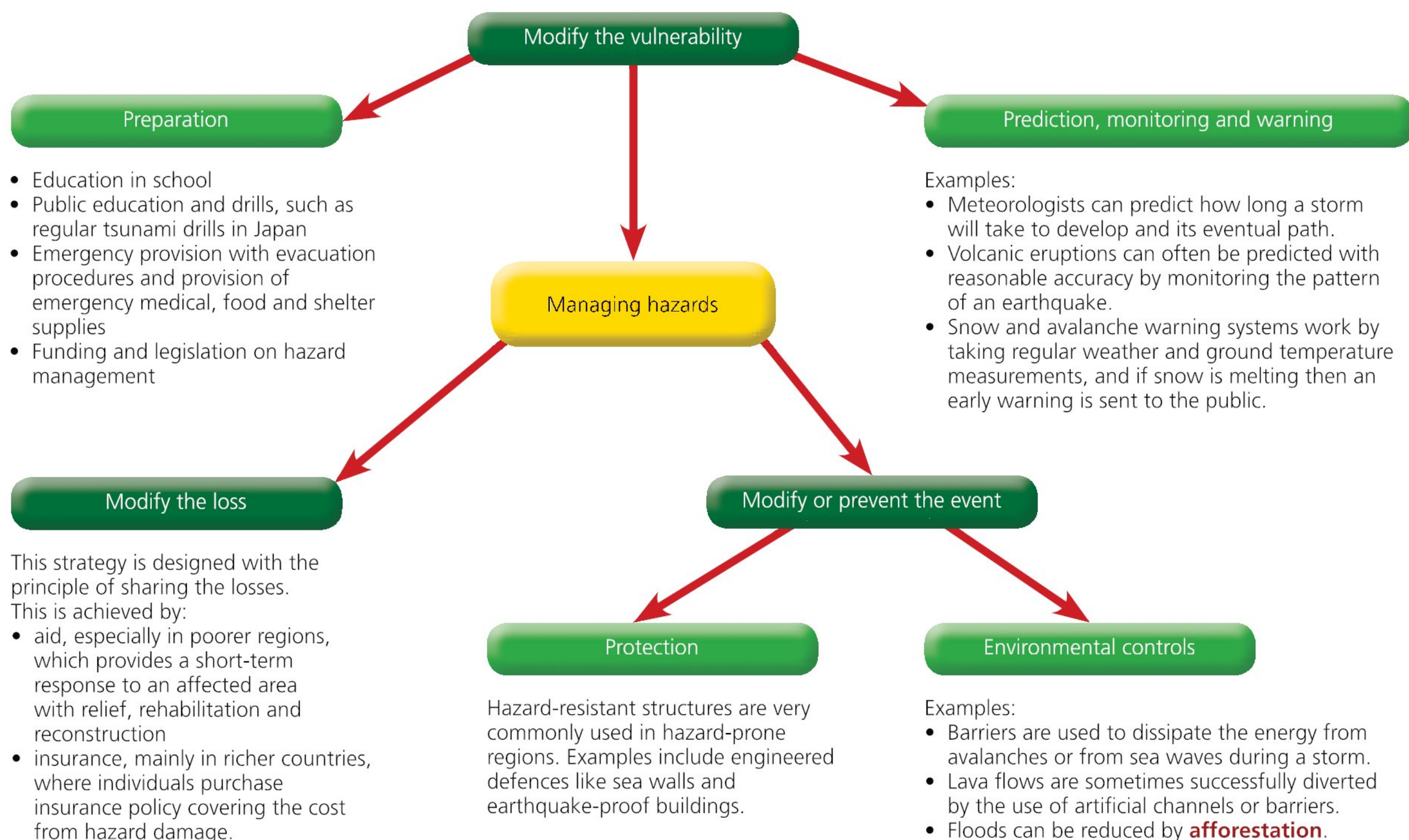
THE HUMAN RESPONSE TO NATURAL HAZARDS

SEE–THINK–WONDER

Study Figure 10.23, which shows students in a Japanese school.

What do you see? What does it make you think?
What does it make you wonder?

The response to natural hazards and their impact on human activity can take place at a range of levels, from individual responses, to local and national governments' plans and international strategies from **supranational organizations**. The choice of response will depend on a diverse set of factors for different parts of the world depending on socio-economic and political systems, which we will explore in the remaining activities of this chapter. Hazards can be managed by modifying the vulnerability of the population, by trying to modify the potential losses and by attempting to modify the event (see Figure 10.22).



■ **Figure 10.22** Managing hazards



■ **Figure 10.23** Students in a Japanese school



■ **Figure 10.24** A Japanese earthquake early warning educational leaflet

ACTIVITY: Prediction and risk management

■ ATL

- Critical-thinking skills: Evaluate evidence and arguments

- 1 Look at Sources A and B. **Suggest** why insurance companies are so involved in risk assessing and management.
- 2 Read Source C. **Summarize** how insurance companies predict risks.
- 3 In pairs, **contrast** the advantages and disadvantages of risk prediction and management by private insurance companies.
- 4 As a class **discuss** the extent to which protection and insurance should be a governmental responsibility rather than a private strategy.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.

SOURCE A



■ **Figure 10.25** A house damaged by flooding in Keswick, UK

ACTIVITY: Hazard management case studies

■ ATL

- Information literacy skills: Collect and analyse data to identify solutions and make informed decisions; Identify primary and secondary sources
- Critical-thinking skills: Interpret data; Evaluate evidence and arguments

Working in two groups, each group is going to **investigate** the human response to hazards in:

- California, USA
- the Philippines.

As a group, **investigate** the hazard management strategies within your region/country. **Discuss** the issues

SOURCE B

‘We have been working on climate change since the 1970s,’ says Ernst Rauch, head of climate and public sector business development at Munich Re [a German reinsurance company]. ‘We are one of the largest risk takers and it is essential we understand these potential risks. This is crucial to us.’

For insurers, the key issue is the resilience of populations and infrastructure – the ability to deal with disasters when they happen. In most situations, this requires government planning, working with the private sector to help proof homes and buildings against severe weather. But while insurers have grown acutely aware of these risks, governments and other parts of the private sector have lagged behind.

‘We see the need at a global scale for societies and public risk managers like government and local authorities to pay more attention to the reduction of risk and resilience building,’ says Rauch. ‘Otherwise we will see an ongoing increase in losses, driven and intensified by climate change.’

Weather catastrophes are now six times more frequent than in 1950. Caspar Honegger, who heads global flood peril assessment at Swiss Re [a Swiss reinsurance company], reports that after Superstorm Sandy hit New York, the city asked his team to analyse the climate risks for the next 40 years. They found that rising sea levels and the increasing frequency of storms would raise average annual losses by 170% to \$4.4bn.

Extract from the Guardian, 1 September 2017

that triggered the need for more effective and more appropriate management of natural hazards. Write a short report that you will have to **present** to the class. Include views from different stakeholders (authorities, scientists, engineers, insurance companies and the affected population), photographs, charts, diagrams and any other useful visual information to support your points.

Use the following websites as a starting point for helping you in your investigation:

- **California, USA:** www.earthquakeauthority.com/
- **The Philippines:** www.theguardian.com/global-development/2014/jul/16/philippines-typhoon-rammasun-disaster-preparedness

In mixed case-study groups, **discuss** the following:

- **Compare and contrast various hazard management strategies across a range of examples.**

- **Suggest which types of hazard management strategy are the most likely to reduce vulnerability. Use evidence to support your views.**

Summarize the issues raised by this activity by writing a report of around 700 words. Use the question below to guide you:

'Evaluate the effectiveness in hazard management strategies in reducing fatalities and economic loss.'

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion B: Investigating, Criterion C: Communicating and Criterion D: Thinking critically.

SOURCE C

Understanding catastrophic risk modeling

According to EQECAT, which together with the ISCM (International Society of Catastrophe Managers), Risk Management Solutions, and AIR WorldWide provides most of the data and projections in this field, catastrophic risk modeling 'provides essential data for global and regional insurers, reinsurers, brokers, financial markets and corporations to evaluate potential and the probability of risk and financial loss from natural hazards.' Catastrophic risk modeling operates at the junction of (and utilizes the research methods, data, and projections of) many different scientific fields, including engineering, meteorology, seismology, and actuarial science. A catastrophic risk model is broken down into 4 modules: the stochastic event module, the hazard module, the vulnerability module, and the financial module.

Stochastic event module

The stochastic event module is the initial phase of catastrophic risk modeling, involving the creation of a stochastic event set and which contains a database of possible catastrophic events, as well as set of data pertaining to the parameters of the events (strength, size, location, likelihood, etc.). Each stochastic event module can contain thousands of event scenarios and possibilities.

Hazard module

The hazard module calculates the hazards for each individual event, measured by and against the specific characteristics and traits of the geographic and physical properties of the location of the event itself. For example, this module would assess and offer a projection of the likely wind speeds of a hurricane, based on the area in which the hurricane was projected to occur.

Vulnerability module

The vulnerability module projects the likely amount of damage for each event, and like the hazard module its projections are region-specific and based on the geographical and physical environment of each event's projected location. For example, a region which has a high likelihood of earthquake occurrence, but has poorly constructed and earthquake-vulnerable buildings will have a much higher expected damage total. Damage projections are made and quantified according to a mean damage ratio, which is calculated by dividing the average anticipated loss by the replacement value.

Financial module

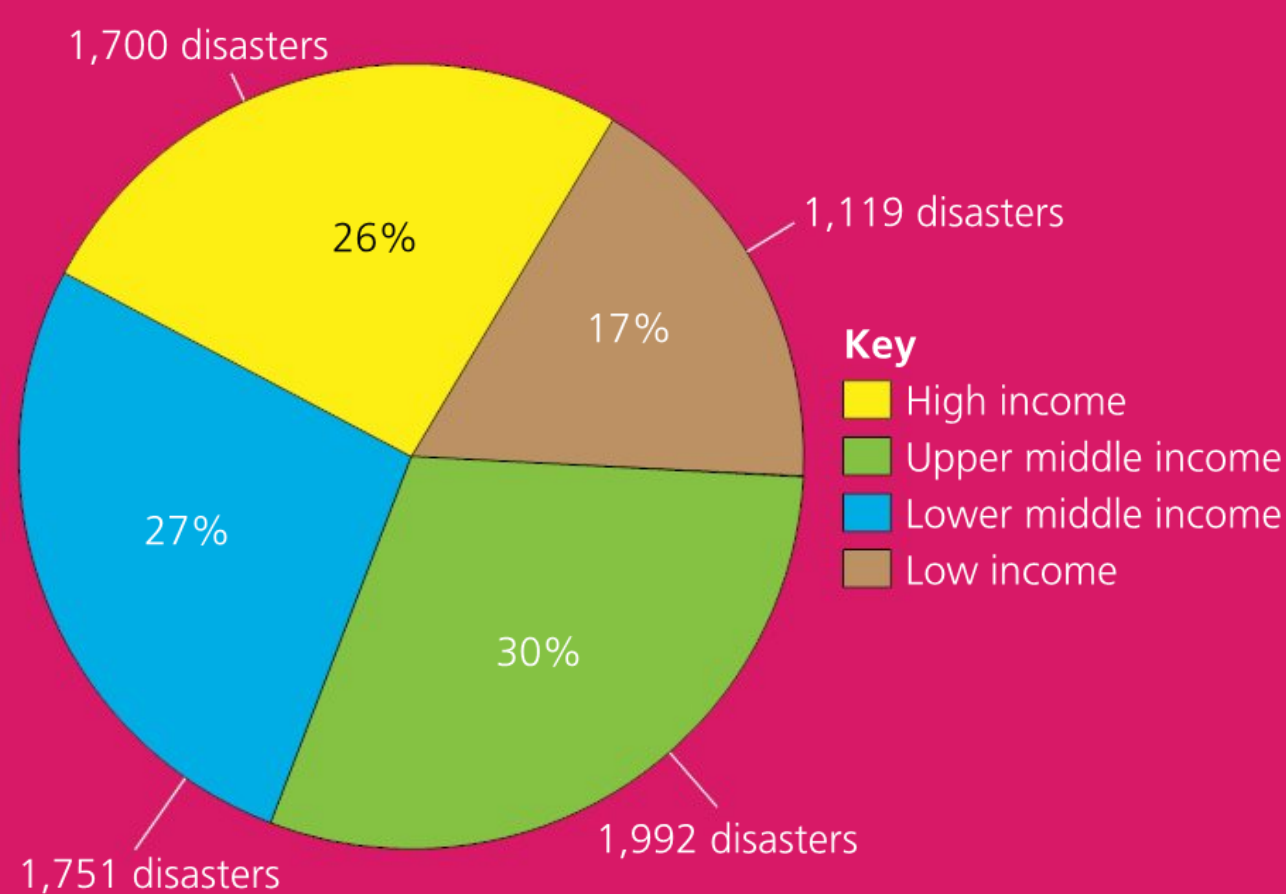
The financial module is the module most relevant for the insurance industry and is best represented as the application of the dataset and its findings. This module translates physical damage cost into real-time, actual financial loss figures. Insurance companies use this module to assess and estimate insured losses by applying the policy conditions of those in the region to the total loss estimates.

Extract from 'Catastrophic Risk Modeling and Recent Disasters: How the Insurance Industry Rides Out the Storms' Forbes.com, 24 August 2012

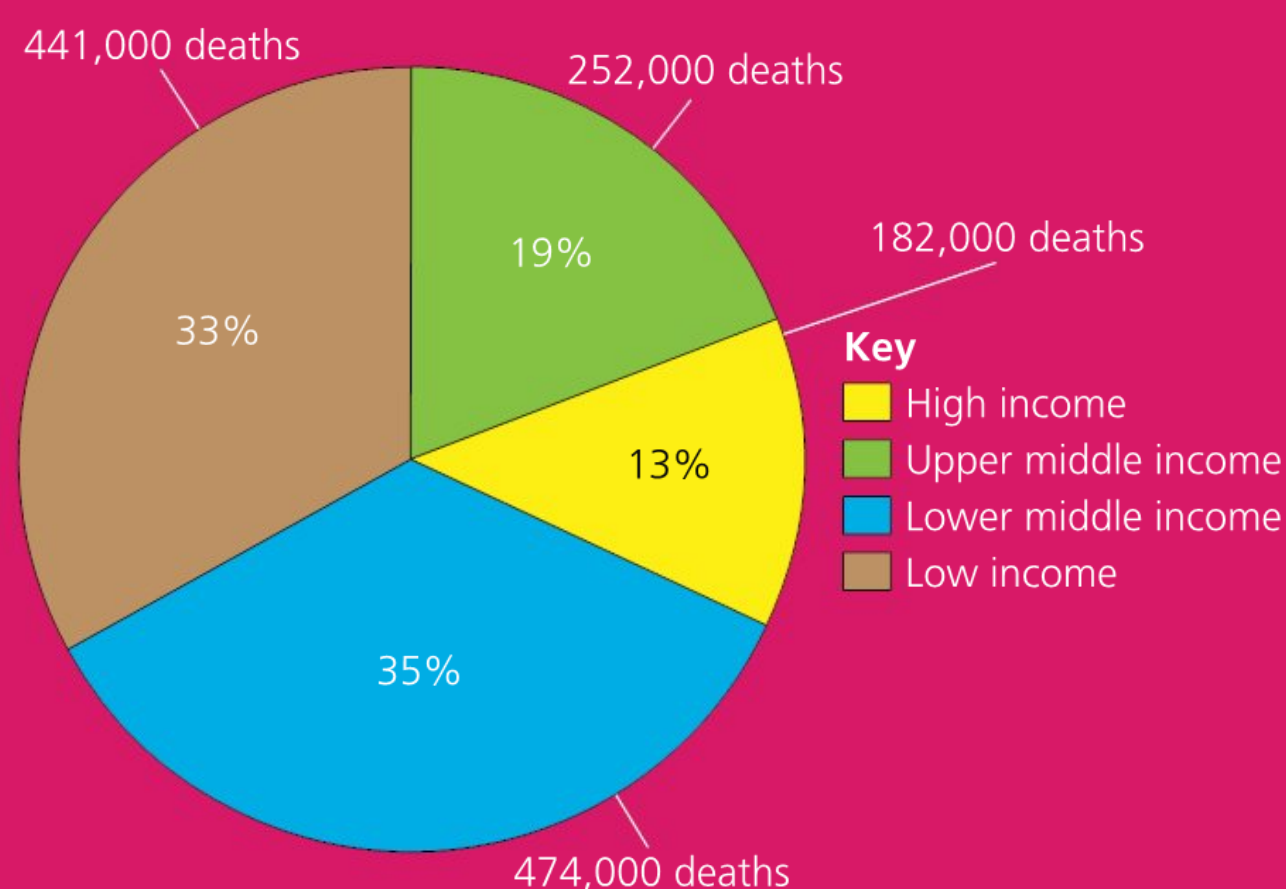
! Take action: Exploring the links between vulnerability and hazard response

■ ATL

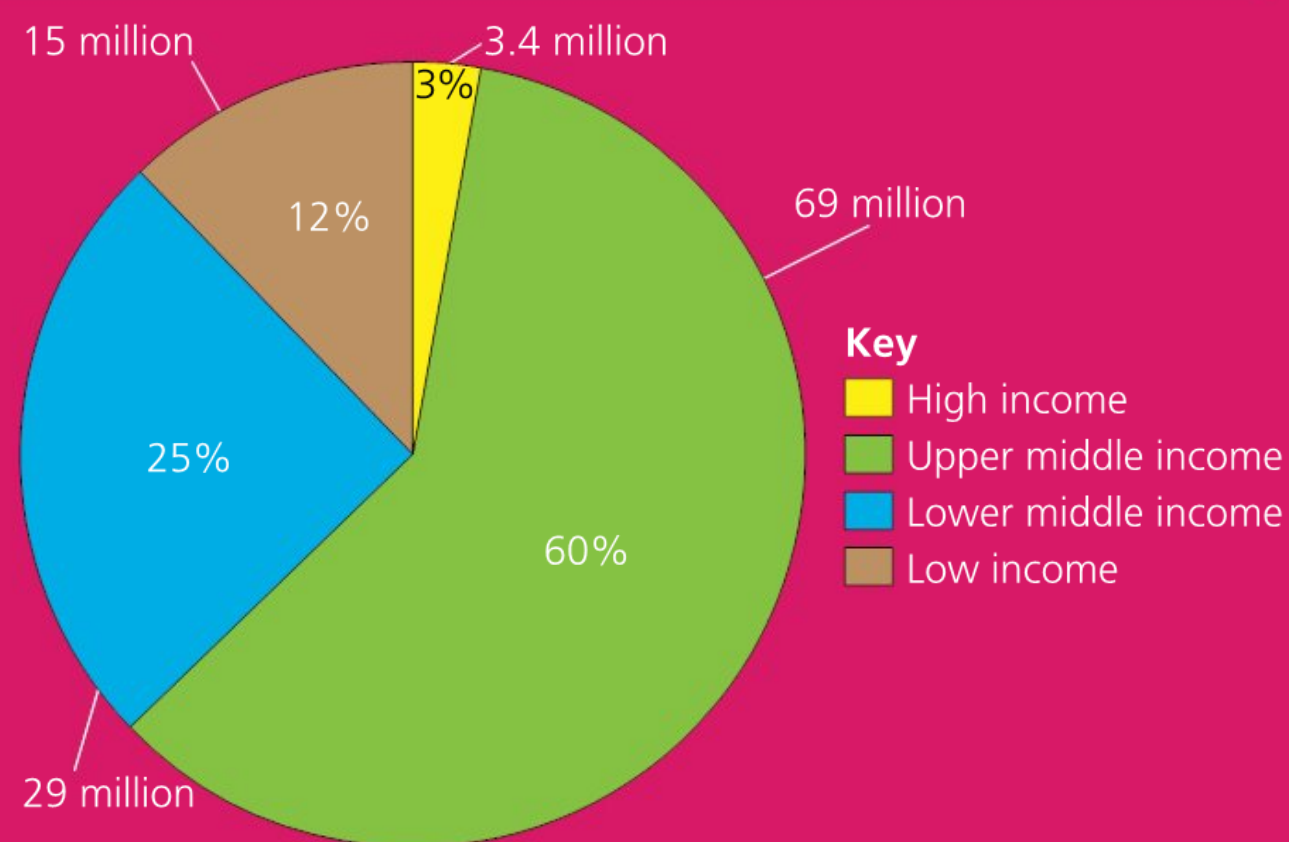
- Information literacy skills: Collect and analyse data to identify solutions and make informed decisions
- Media literacy skills: Seek a range of perspectives from multiple and varied sources



■ **Figure 10.26** Number of disasters per income group, 1994–2013



■ **Figure 10.27** Number of deaths per income group, 1994–2013



■ **Figure 10.28** Number of damaged houses per income group, 1994–2013

- 1 **Analyse** Figures 10.26–10.28 by describing and comparing the number of deaths, the number of damaged houses and the degree of vulnerability across income groups.
- 2 **Suggest** reasons for the disparities in damage and vulnerability.
- 3 **Reflect** on the outcomes of this activity by writing a letter raising issues about hazard vulnerability. You could send your letter to a Non-Governmental Organization (NGO) involved in supporting victims of natural disasters or campaigning on the issue of climate change.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion B: Investigating, Criterion C: Communicating and Criterion D: Thinking critically.

Reflection

In this chapter, we have **described** the difference between hazards and disasters, **examined** the global trends in natural disasters and **explained** how hazards can be classified depending on their magnitude and frequency. We have **analysed** the differences in risk, vulnerability and hazard perception from contrasting places around the globe and **summarized** the impacts from natural hazards on communities around the globe. We have **taken action** to find the most appropriate ways to respond to natural disasters.

Use this table to reflect on your own learning in this chapter.					
Questions we asked	Answers we found	Any further questions now?			
Factual: What are natural hazards and natural disasters? What is the global trend in natural disasters? What are the main types of hazards?					
Conceptual: How do natural hazards change in scale, magnitude and frequency? Why are some places more vulnerable than others?					
Debatable: Is it ever possible to be completely prepared for natural disasters?					
Approaches to learning you used in this chapter:	Description – what new skills did you learn?	How well did you master the skills?			
		Novice	Learner	Practitioner	Expert
Communication skills					
Critical-thinking skills					
Information literacy skills					
Media literacy skills					
Reflection skills					
Transfer skills					
Learner profile disposition	Reflect on the importance of being a good inquirer for your learning in this chapter.				
Inquirer					

11

Can tectonically active areas all be managed in the same way?



- Tectonic **activity** in different **times and places** has different **impacts** according to the **technologies** we can deploy to manage them.

CONSIDER THESE QUESTIONS:

Factual: What causes tectonic activity? What happens during an earthquake and a volcanic eruption?

Conceptual: What effects do tectonic processes have on people in different contexts?

Debatable: Can technology help predict earthquakes and volcanic eruptions in every place? To what extent can technology limit the impact of tectonic hazards?

Now **share and compare** your thoughts and ideas with your partner, or with the whole class.



■ **Figure 11.1** Effects on the population of the Mount Kelud eruption, Indonesia

IN THIS CHAPTER, WE WILL ...

- **Find out** how different plate margins result in a range of tectonic processes and how tectonically active areas offer both opportunities and challenges.
- **Explore** different volcanoes and earthquake zones using geospatial technology; the role of innovations in making hazard-prone areas safer, and the impacts of earthquakes and volcanoes on communities around the globe.
- **Take action** to find the most appropriate ways to respond to tectonic hazards in poor countries.

◆ Assessment opportunities in this chapter:

- ◆ Criterion A: Knowing and understanding
- ◆ Criterion B: Investigating
- ◆ Criterion C: Communicating
- ◆ Criterion D: Thinking critically

● We will reflect on this learner profile attribute ...

- Inquirer – we will develop skills for inquiry and research.

■ These Approaches to Learning (ATL) skills will be useful ...

- Collaboration skills
- Communication skills
- Creative-thinking skills
- Critical-thinking skills
- Information literacy skills
- Media literacy skills
- Transfer skills

KEY WORDS

distribution
innovation
management

processes
relief



■ **Figure 11.2** A curling stone, made of granite



■ **Figure 11.3** An Egyptian cat goddess statue, made of basalt

SEE-THINK-WONDER

Study Figures 11.2 and 11.3 which show objects made from granite and basalt, the two most abundant **igneous rocks** in the Earth's crust.

What do you see? What does it make you think?
What does it make you wonder?

Research

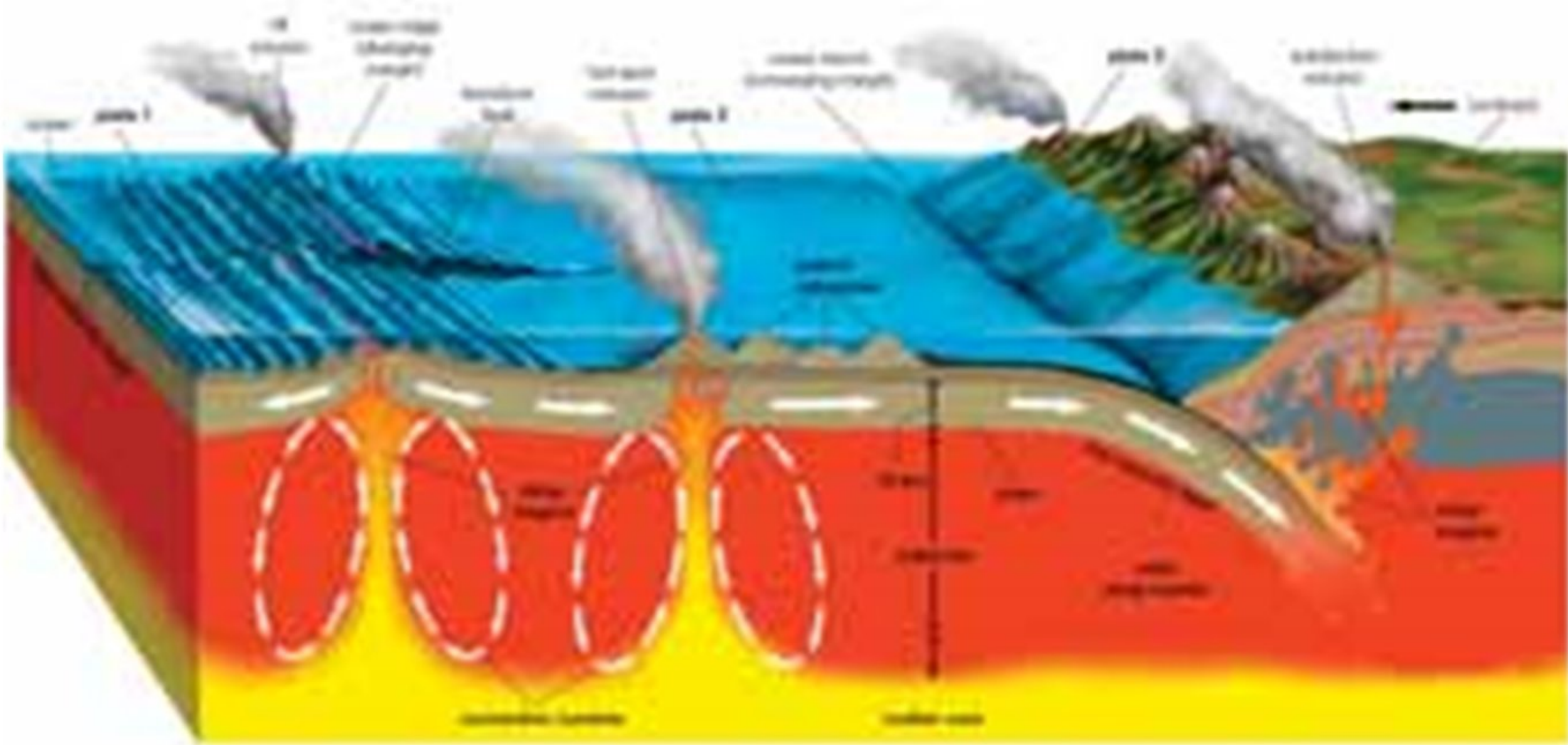
Search online for [granite encyclopedia.com](http://granite.encyclopedia.com) and [basalt encyclopedia.com](http://basalt.encyclopedia.com) to **find** out more about the main types of rocks in the Earth's crust.

What causes tectonic activity?

AN UNSTABLE EARTH'S CRUST

The heat from the Earth's interior is so intense that it constantly reshapes the outermost and thinnest layer of the

Earth: the crust. Scientists disagree as to what creates this internal heat system; some say that it comes from radioactive decay from the deep core and others claim that the heat actually comes from the mantle. What is certain is that the temperature difference between the hotter lower mantle and the cooler crust, which is made of several separate plates, creates **convection currents** (see Figure 11.4). Less dense hot magma rises and denser cool magma sinks, dragging the Earth's plates apart in some areas and pushing them together in others. These movements produce stresses in the crust, resulting in tectonic processes.



■ **Figure 11.4** How plates move

THINK–PAIR–SHARE

Look at the key terms below. These terms are essential to understand the concepts and ideas from this chapter. You could refer back to the *MYP Individuals & Societies by Concept 1–3* to check some terms you have come across before. There are also some new terms that you will find out about in this chapter.

Think about how you would **define** them yourself, then share your definitions with a partner and then finally share them with the rest of the class.

You could check your understanding using:
<https://en.oxforddictionaries.com/>

Are there any new key terms that the whole class needs to **investigate** further?

plate tectonics	lithosphere	continental crust	fault	margin
convection cell	oceanic crust	igneous rock	subduction	active zones

ACTIVITY: The distribution of earthquakes and volcanoes

■ ATL

- Critical-thinking skills: Practise observing carefully in order to recognize problems

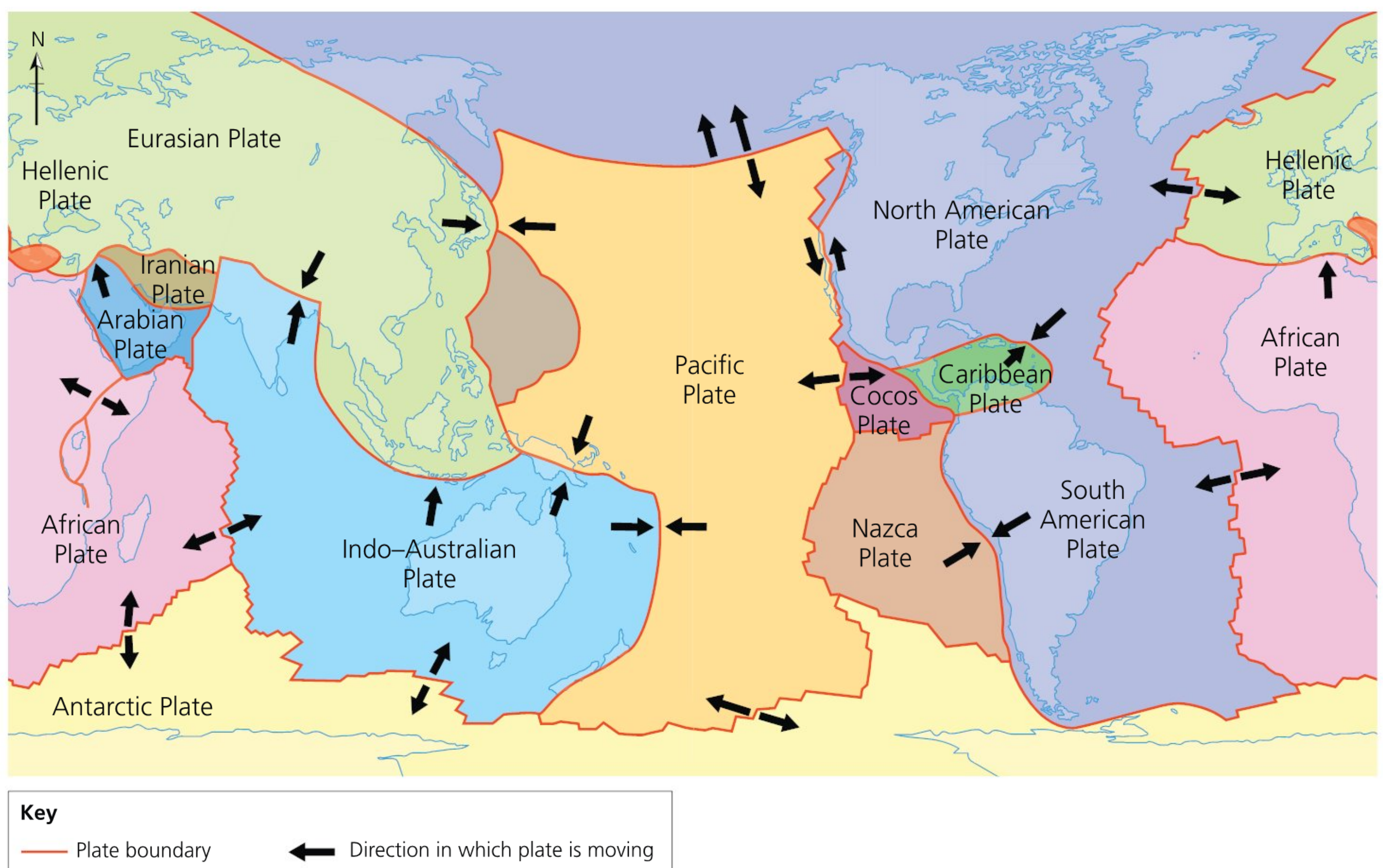
Look at the map in Figure 11.24 on page 257. Working in pairs, **describe** the distribution of earthquakes and volcanoes. Your description should use the TEA map-description technique (see page 12). Ensure you keep a record of your discussion, using TEA to structure your notes.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.

It is at the boundaries where plates meet, the so-called margins, that tectonic processes are the most intense, leading to earthquakes and volcanoes (see Figure 11.5). Later in this chapter, we will explore some of the world's most famous active zones where earthquake and volcanic activity is the greatest.

The global distribution of earthquakes and volcanoes illustrates how varied the range of tectonic processes can be in different spaces. A combination of several tectonic processes will affect places in different ways but the number of times that places are affected by tectonic events will also be a determining factor in how communities respond.



■ **Figure 11.5** Plate boundaries and active zones of the Earth's crust



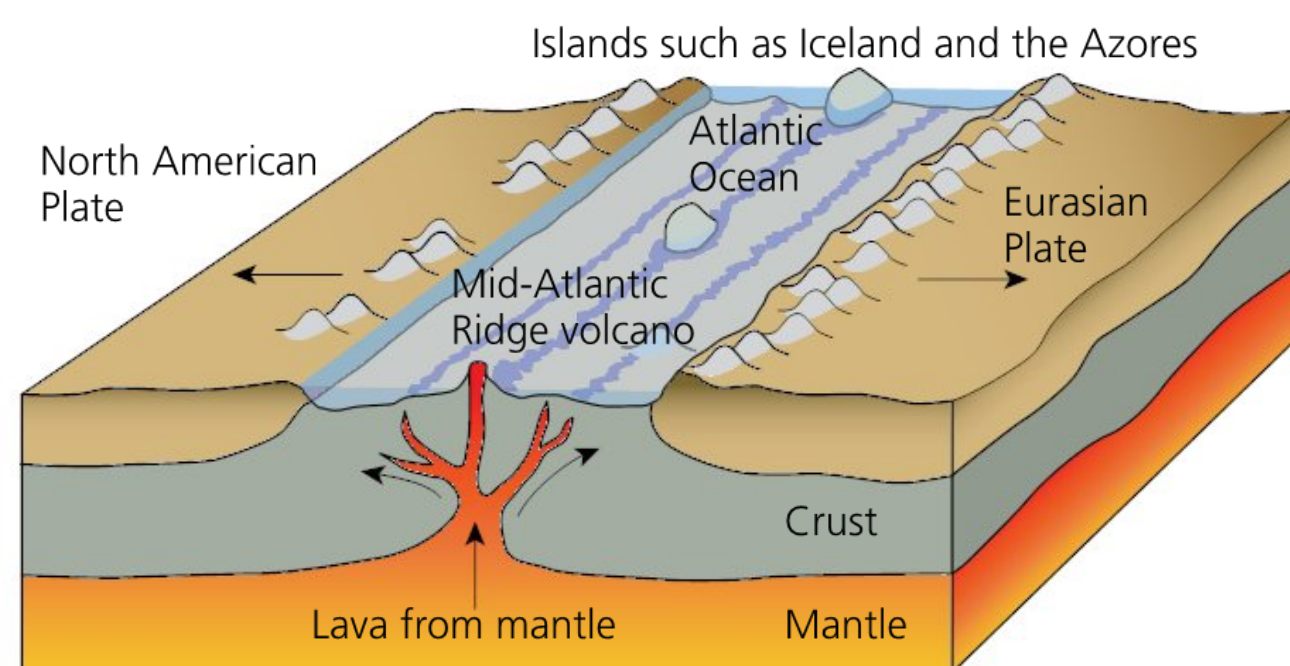
■ **Figure 11.6** (a) The Mariana trench, (b) a road in San Andreas, California, (c) the Blue Lagoon in Iceland

SEE-THINK-WONDER

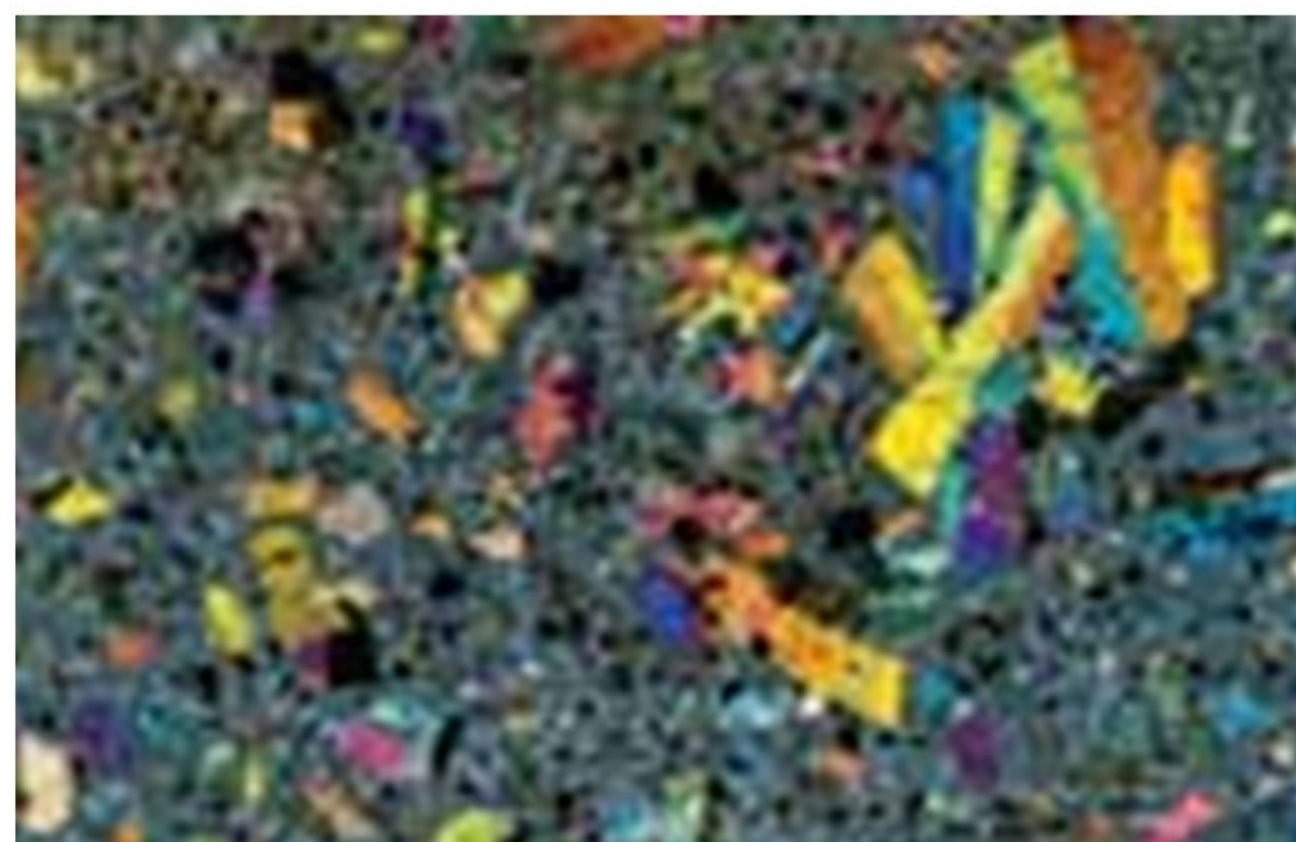
Study the photos in Figure 11.6. What do you see? Make sure your observations are as accurate as possible. What do you think might be going on in each photo? Try to **explore** a range of options. What do you wonder about each photo?

PLATE MARGINS

At the beginning of this chapter we looked at two igneous rocks, basalt and granite. These rocks form in different places and the way they are made illustrates why tectonic processes are so varied and therefore so difficult to respond to. We already know that plates are constantly on the move, pushed in all directions by the conveyor belt system of the convection currents.

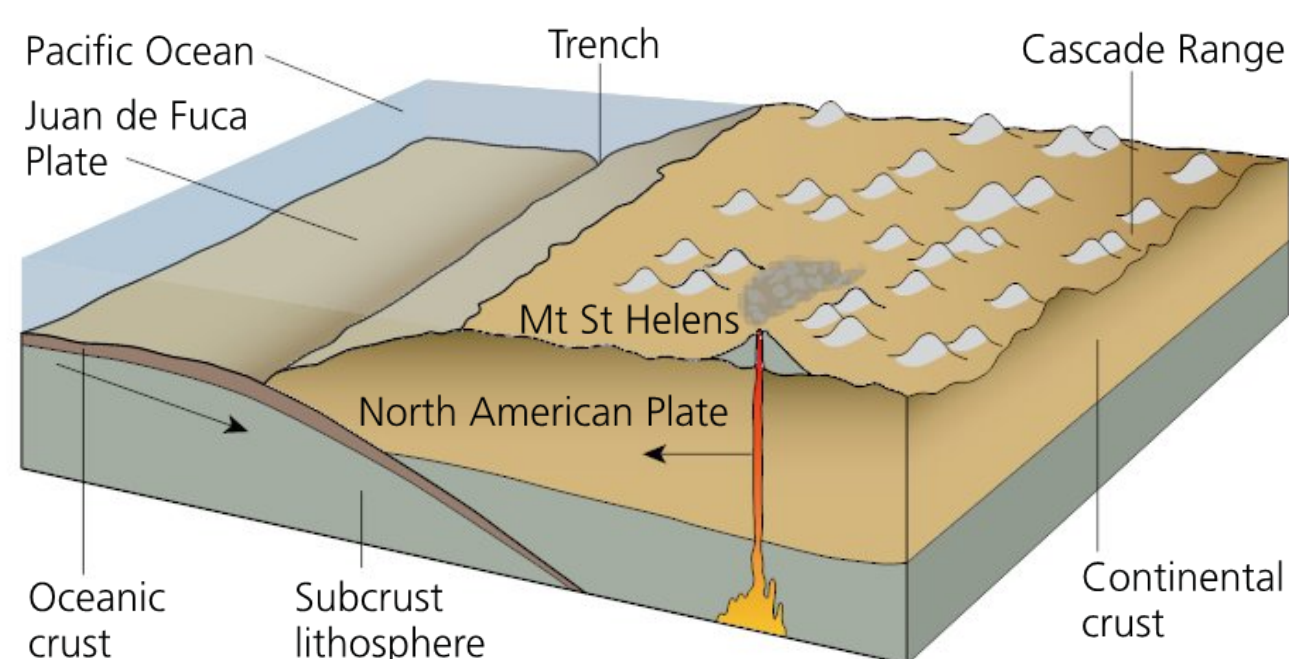


■ **Figure 11.7** Constructive plate margin – the Mid-Atlantic Ridge and Iceland



■ **Figure 11.8** An essexite rock sample showing just a few coloured silica (quartz) inclusions within basalt

- At constructive plate margins (see Figure 11.7), where oceanic plates move in opposite directions, magma in the mantle is fluid, hot (1,000–1,200°C) and contains only small amounts of **silica**. (The best-known silica mineral is quartz which is used in the manufacture of glass – see Figure 11.8.) This is where the basalt of the Egyptian cat goddess in Figure 11.3 is formed. The diverging movement of the plates allows the magma to escape easily, leaving little resistance and causing only shallow earthquakes along the margin while building new seafloor and ocean ridges. This means that earthquakes are low intensity and volcanic eruptions are frequent but gentle. The magma that escapes through a constructive margin cools rapidly, which means that crystals, such as quartz, have less time to form.

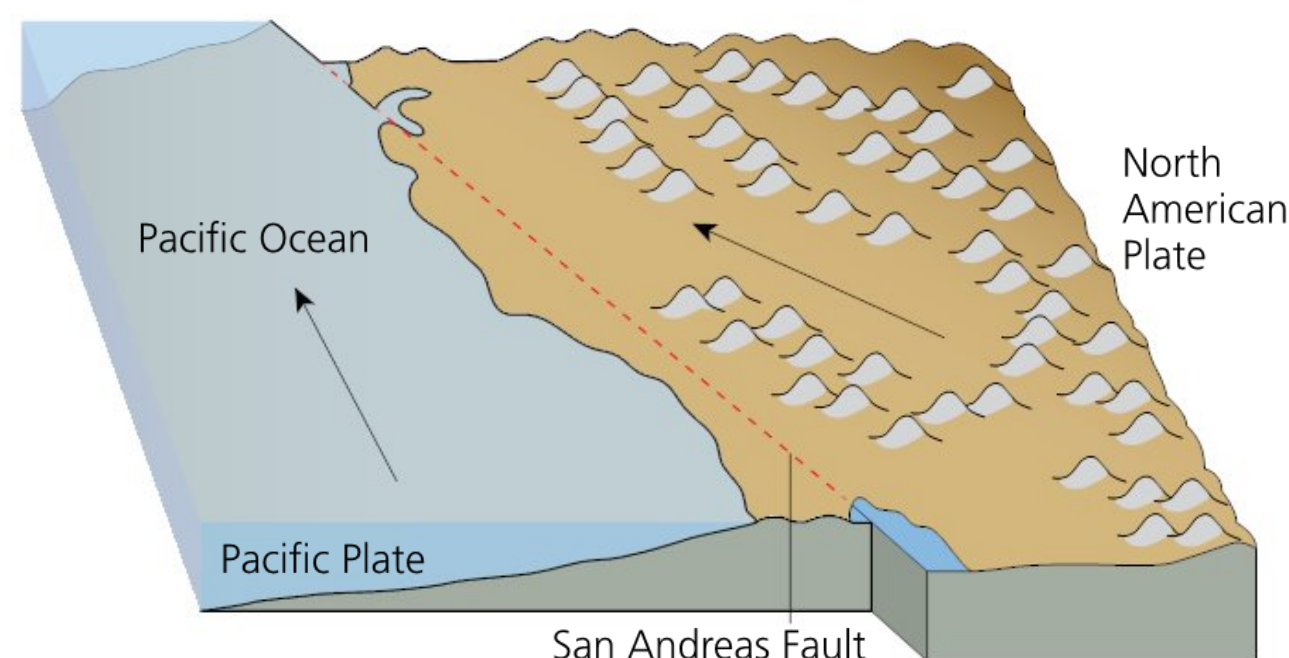


■ **Figure 11.9** Destructive plate margin – the Cascade Range in North America

- At destructive plate margins (see Figure 11.9), where an oceanic crust subducts under a continental crust, thus creating deep sea trenches, the magma is cooler (600–1,000°C) and contains a higher silica content (see Figure 11.10). Most of the magma comes from the crust which is constantly being destroyed during the subduction process. Above all, it is significantly less fluid and takes more time to cool down, which means that crystals such as quartz have more time to form. This is how the granite of the curling stone in Figure 11.2 is made. The viscous magma does not escape easily, making it more difficult for gas to escape and causing pressure to build up at the margin. This, combined with the compressional force of the subducting and colliding plates, increases the frequency of high intensity earthquakes and more violent volcanic eruptions.
- The final type of tectonic process takes place at conservative margins (see Figure 11.11), where plates move past each other but are not destroyed or constructed. The motion along faults causes stress to build up over long periods of time, producing less frequent but stronger earthquakes.



■ **Figure 11.10** A granite rock sample showing a wide range of coloured crystal inclusions such as feldspar, silica and mica



■ **Figure 11.11** Conservative plate margin – the San Andreas Fault

ACTIVITY: Reviewing plate margins through diagrams

■ ATL

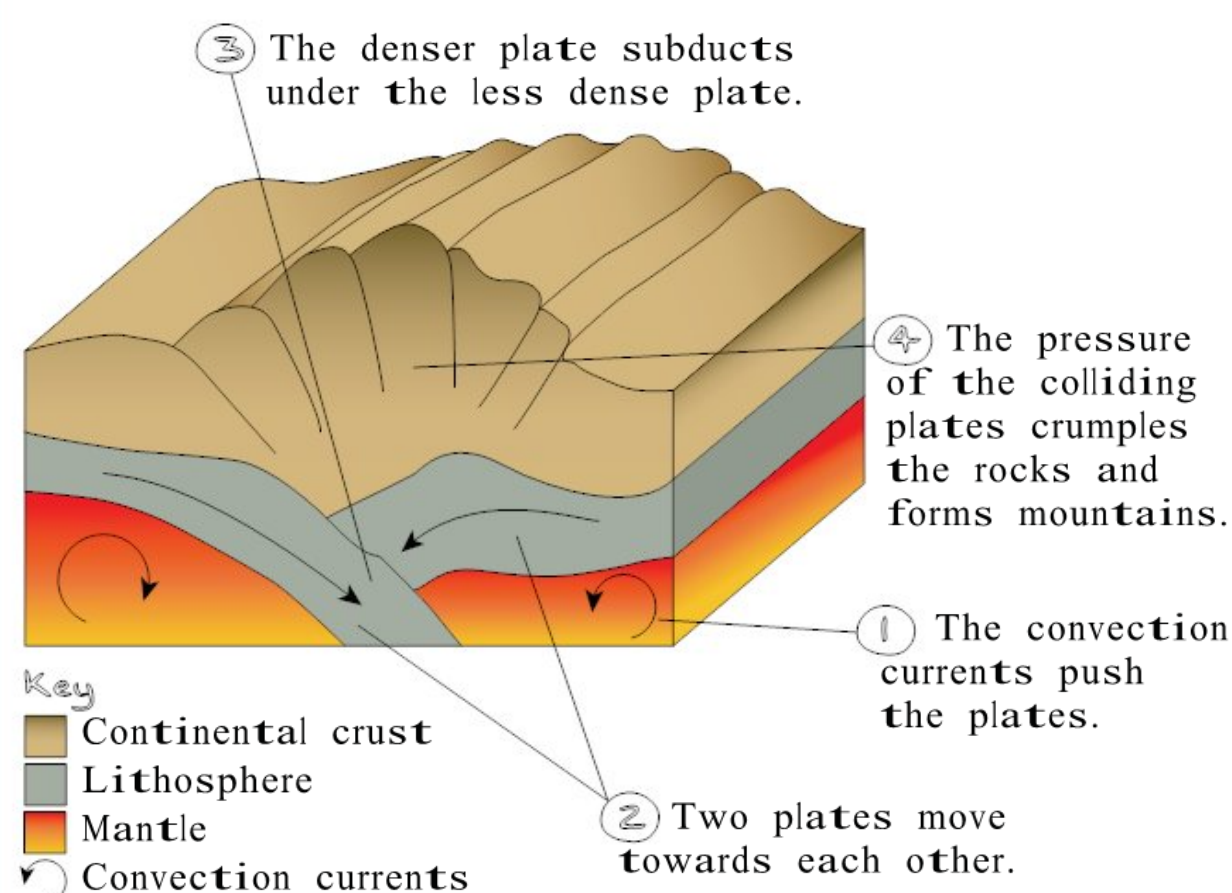
- Creative-thinking skills: Create original works and ideas; Use existing works and ideas in new ways
- Communication skills: Organize and depict information logically

Create your own revision aid, or one to share with others, on the three main types of plate margins: constructive, destructive and conservative.

Your challenge is to **describe** and **explain** the tectonic processes and associated landforms for each margin using annotated diagrams only.

You should make your diagrams clear and easy to revise from by sequencing your annotations.

Figure 11.12 shows how to sequence annotations. Also refer to the Annotating diagrams box on the right.



■ **Figure 11.12** Collision plate margin

You can either choose your diagrams from an internet source and then **annotate** them on your computer or hand draw them and add handwritten annotations.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion C: Communicating.



Annotating diagrams

Annotated diagrams are a good way to visually emphasize particular ideas and can be used to support explanations within essays, examination answers or more creative pieces.

Make effective annotated diagrams by following the steps in Figure 11.13.

Plan the size, design and type of diagram. You might be required to add some explanations to the diagram, elaborating on specific features and processes, so make sure the one you are using is large and clear. If you are using a diagram from the internet, make sure it does not have any existing annotations.

Before starting the annotations, brainstorm or research any key terms that apply to the theme or question you are answering.

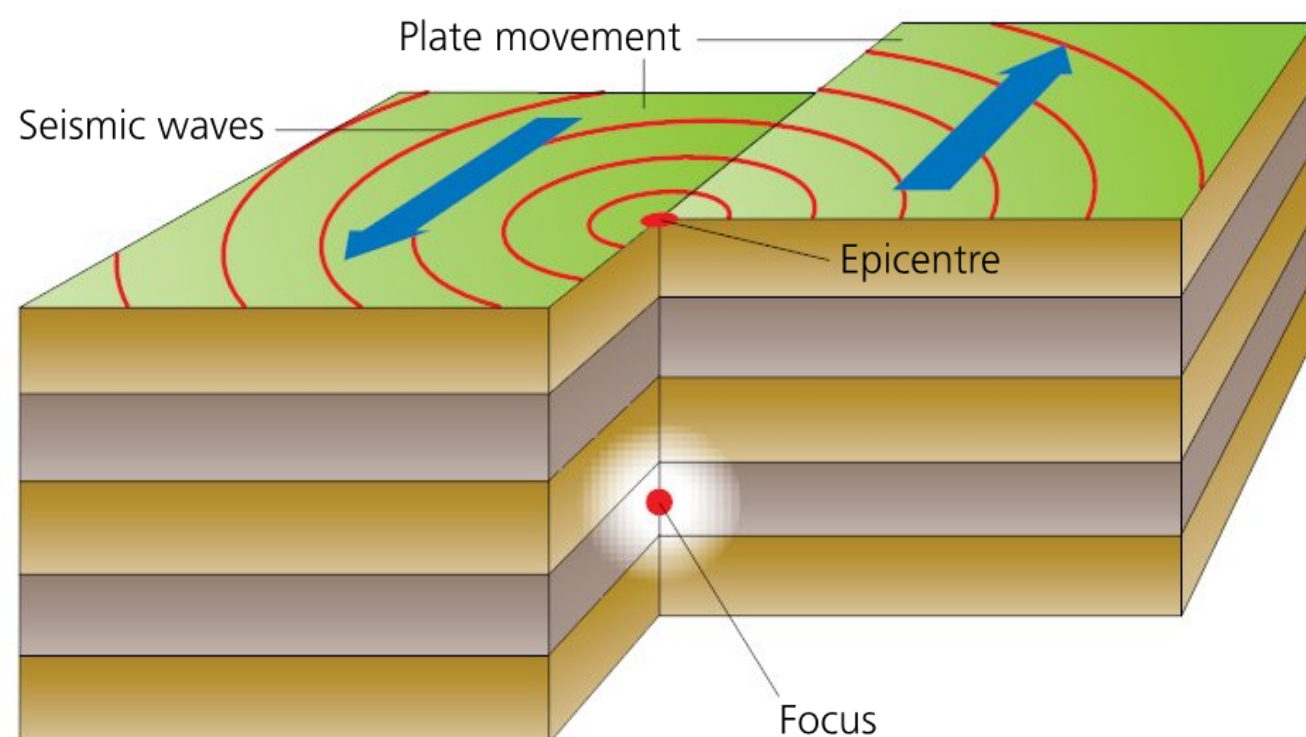
If you are answering an 'explain' question, make sure you think about sequencing your annotations. This means that your explanation needs to show a logical order, starting with the process and then moving on to the result of the process. Several processes may occur in the formation of geographical features, so there should be a logical order to all the processes involved. Start each annotation with a number so the processes are described and explained in the right order. Add the specific key terms to help focus your explanation.

Make sure you use arrows or lines that connect accurately to the feature you describe or explain.

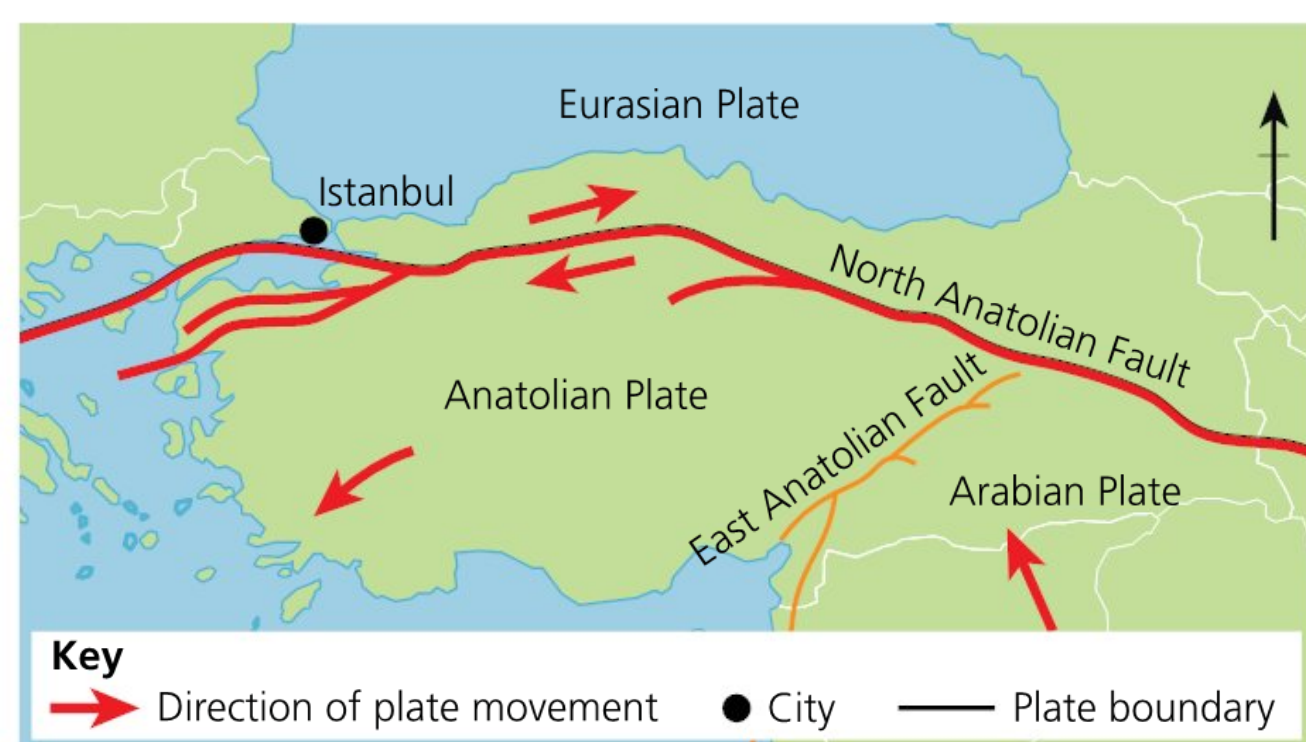
■ **Figure 11.13** Annotating diagrams

What happens during an earthquake and a volcanic eruption?

THE NATURE OF EARTHQUAKES



■ **Figure 11.14** Earthquake diagram



■ **Figure 11.15** The Anatolian Fault



■ **Figure 11.16** 1894 Istanbul earthquake damage

Most earthquakes are the result of sudden movements or 'slips' along fractures, called faults, in oceanic and continental crusts. Plate margins have a large number of these faults which are usually grouped into fault zones. Stress builds up over time and then gets released suddenly. The point in the crust where the energy is released is called a focus. Shock waves then travel in different directions and at different speeds, away from the focus (see Figure 11.14). P-waves (primary waves) are the fastest and are detected by seismometers first. They are longitudinal waves, which means the vibrations move in the same direction as the direction of travel and they can travel through both solids and liquids. S-waves (secondary waves) are relatively slower so they arrive later at the detector of a seismometer. They are transverse waves with vibrations at right angles to the direction of travel. In contrast to P-waves, they can only travel through solids.

The concept of time is essential for understanding earthquakes. Stress builds up over decades or centuries due to plate movements, and is sometimes worsened by volcanic activity. If the stress loading time between two earthquakes is small, then the next earthquake will be small, but if the stress loading occurs over a long period of time then the likelihood of a large earthquake increases.

Seismologists who have analysed historical records of past earthquake activity along the Anatolian Fault near Istanbul in Turkey (see Figure 11.15) are expecting the next 'Big One' at any moment as the fault has not slipped since the last major earthquake in 1894 (see Figure 11.16) when an estimated 1,349 people were killed – a significant death toll for the city at the time. What would be the consequences of an earthquake of a similar size in Istanbul today?

DISCUSS

According to the United States Geological Survey (USGS): 'Earthquakes can strike any location at any time.'

To what extent do you agree with this statement?

Discuss in pairs or in small groups, supporting your points with maps, pictures or graphical evidence.

ACTIVITY: Earthquake step by step

■ ATL

- Information literacy skills: Present information in a variety of formats and platforms

Use the information on page 253 to **explain** how earthquakes occur. Before attempting your answer, make sure that you clearly **identify** the features and processes involved.

Choose your format to **explain** the step-by-step sequence:

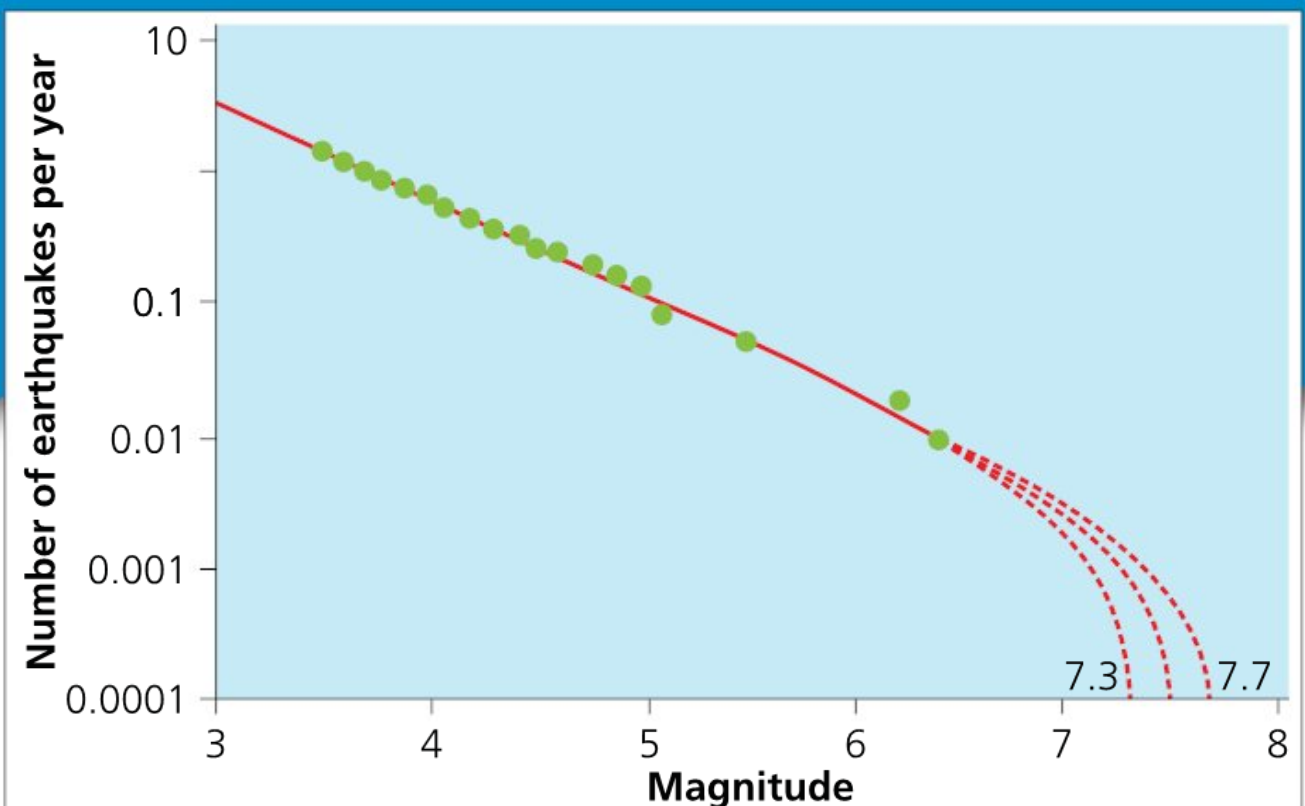
- Numbered steps and bullet points
- Annotated diagrams
- Full extended prose with paragraph structure

Hint

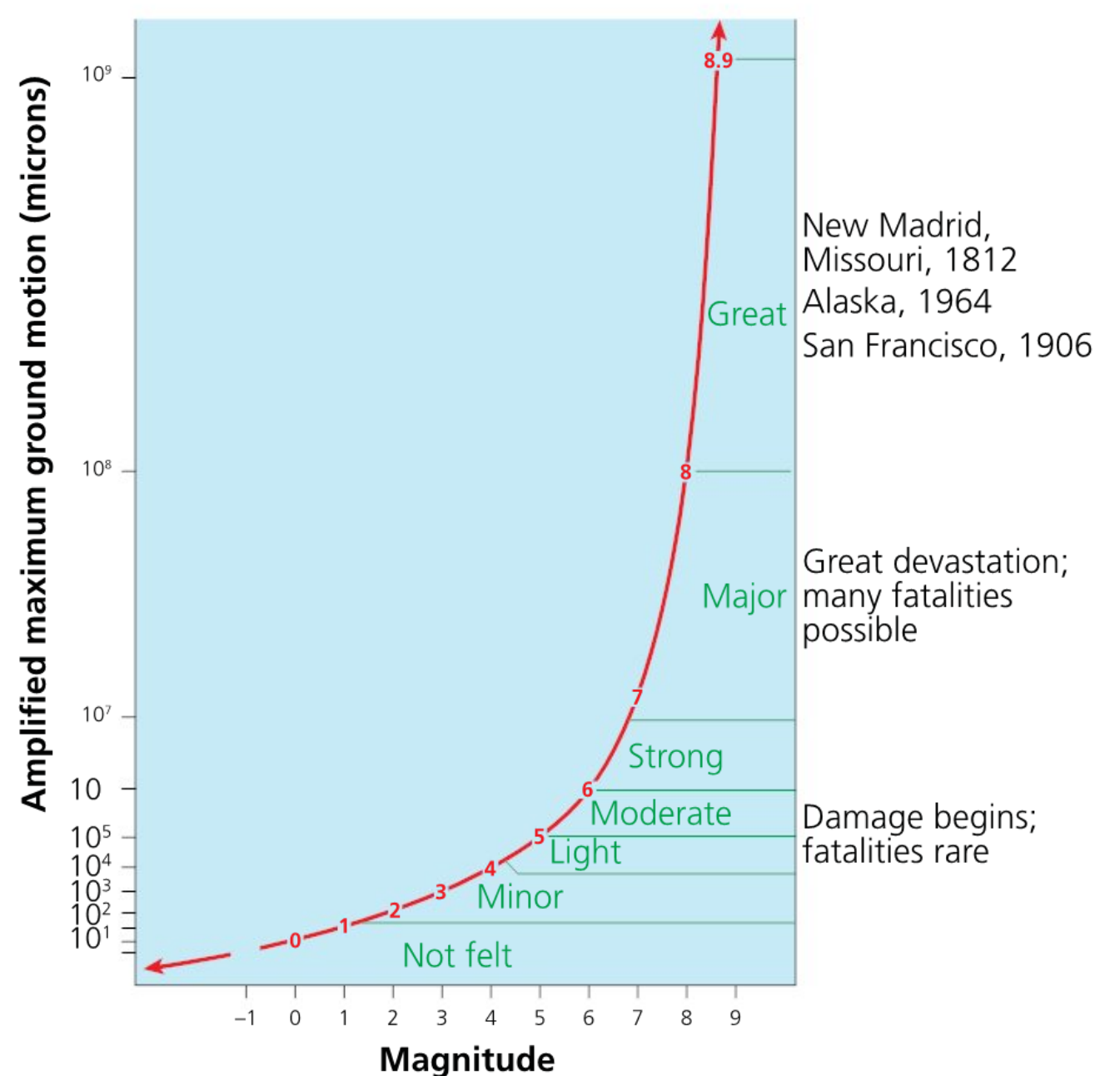
When **explaining** the sequence of processes for an earthquake, or a volcanic eruption, the first step is the same: 'Convection currents in the mantle push the plates'.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowledge and understanding and Criterion C: Communicating.



■ **Figure 11.17** Number of earthquakes per year against magnitude (Richter scale)



■ **Figure 11.18** The Richter scale

FREQUENCY, MAGNITUDE AND INTENSITY

ACTIVITY: Intensity, magnitude and frequency

■ ATL

- Critical-thinking skills: Interpret data
- Communication skills: Use and interpret a range of discipline-specific terms and symbols

- 1 Research the definitions for the following key terms:
 - Intensity
 - Magnitude
 - Frequency
 You could check them using:
<https://en.oxforddictionaries.com/>
- 2 In pairs, reflect on these definitions. What are the differences between them? **Suggest** how these different earthquake features might be measured.

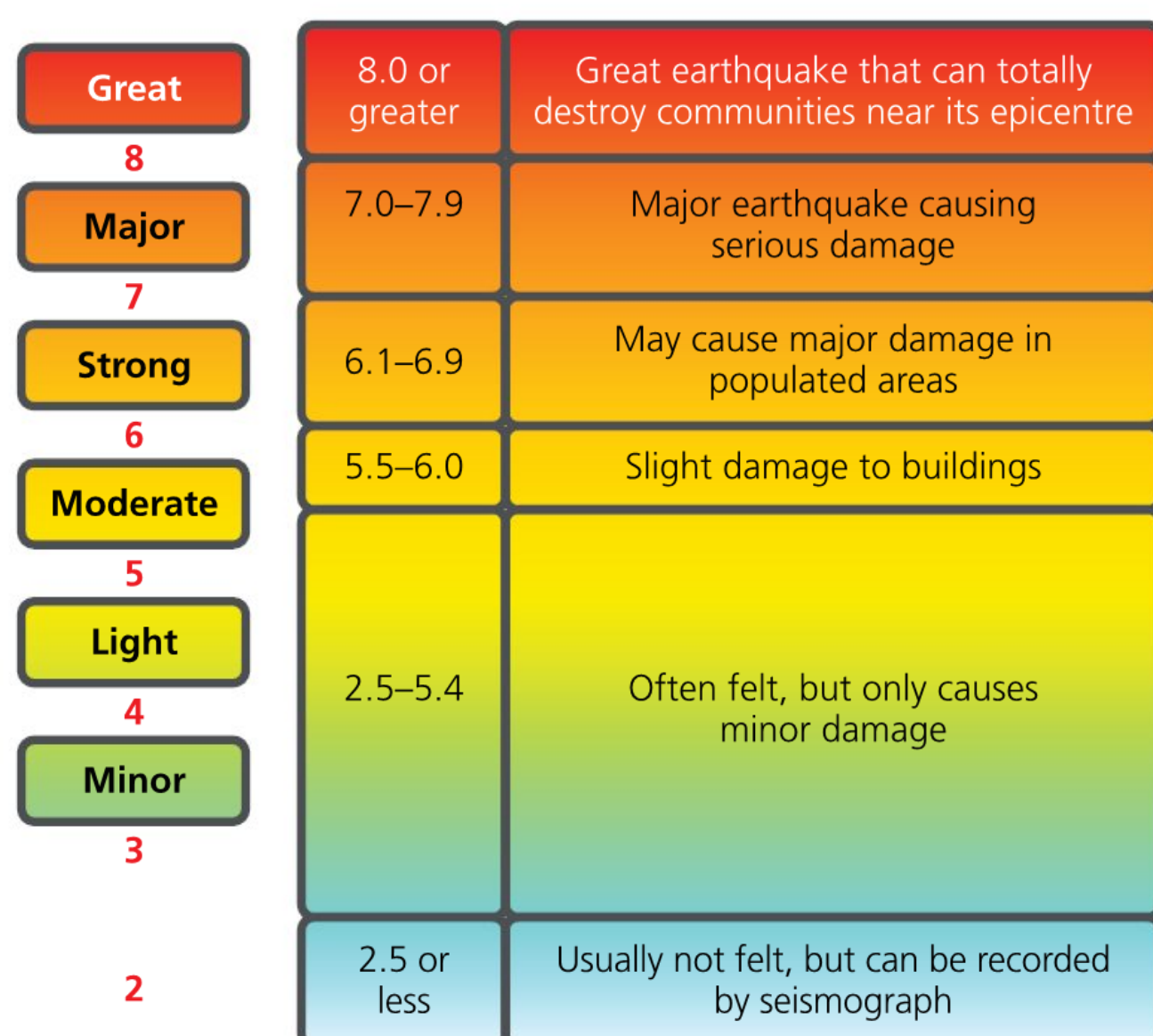
- 3 Look at the two graphs and the table in Figures 11.17, 11.18 and 11.19. **Describe** the information in the graphs using one or more of the key terms. **Justify** your choices.

DISCUSS

Now work with a partner and **compare** your choices. Do you agree? If not, why?

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowledge and understanding and Criterion D: Thinking critically.

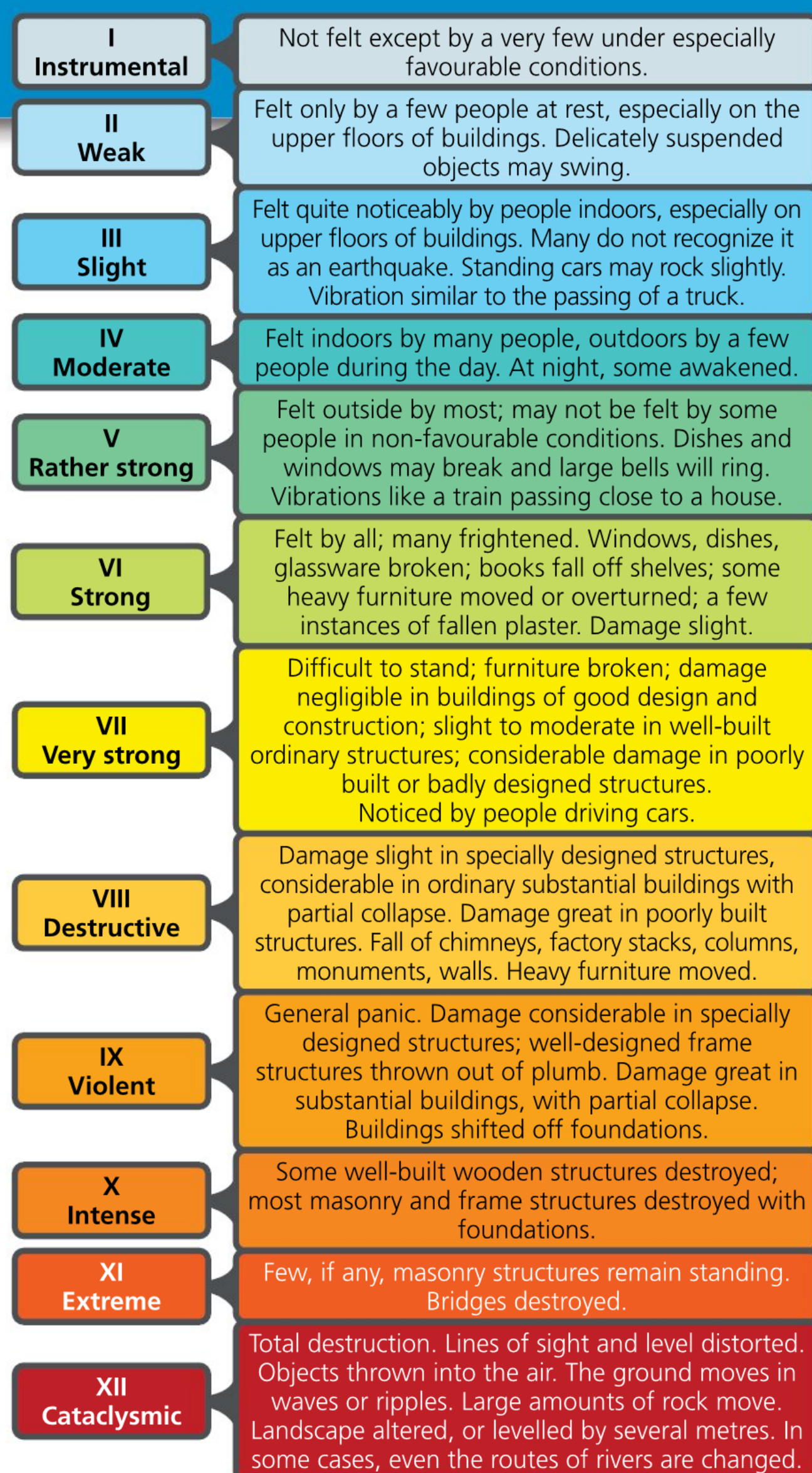


■ **Figure 11.19** Richter scale Earthquake Magnitude

How are earthquakes measured? The amount of energy released by an earthquake can be quantified by measuring its magnitude, which is the amplitude of the lines drawn on a seismogram (see Figures 11.21 and 11.22). A seismogram is a graphical representation of the ground motion as picked up by a seismometer the sensor and a seismic recording system which draws the earthquake trace (see Figure 11.22).

The sensor and the recording device do not have to be in the same place. Sensors are often located near tectonically active areas where earthquake activity is the most intense but the recorder can be located thousands of kilometres away in research stations. The extensive monitoring by the USA of the USSR's nuclear weapons testing in the 1950s helped to establish the technology, with sensors spread all over the world. Seismometers are still used today for monitoring countries which are non-signatories of the UN's Comprehensive Nuclear-Test-Ban Treaty, including North Korea.

The *magnitude* of an earthquake is measured using the Richter scale (see Figure 11.19). This is a logarithmic scale, where each point on the scale represents an increase in magnitude by ten times the previous point: so, an earthquake measured at 8 is 10 times stronger than one measured at 7 and 100 times stronger than one measured at 6.



■ **Figure 11.20** The Mercalli scale

The *intensity* of an earthquake only measures the amount of ground shaking, represented by a qualitative scale of the effects of an earthquake on places not spaces, called the Mercalli scale (see Figure 11.20). This scale measures the observed effects on people, buildings and infrastructure rather than the crust or the ground.



Note: A *seismogram* is the recording of seismic waves which are picked up by a sensor called a *seisometer*, which itself is located within a *seismograph*, a box with other instruments such as in Figure 11.23.



■ **Figure 11.21** An 'old school' (analogue) seismogram trace



■ **Figure 11.22** A computer generated (digital) seismogram trace



■ **Figure 11.23** A technician checking a seismograph station

▼ Links to: Mathematics and Sciences

Think about how you use graphs in mathematics and science classes. They are one of the most common visual techniques used by geographers alongside maps.

A simple line graph showing how one variable changes against another is an arithmetic graph. Arithmetic graphs are used with linear scales, where divisions on the axes represent equal amounts of the data.

We have discovered that the Richter scale has a logarithmic scale. This is when the scale is divided into a number of cycles each representing a tenfold increase in the range of values. If the first cycle ranges from 1 to 10, the second extends from 10 to 100, the third from 100 to 1,000 and so on. Unlike arithmetic graphs, each division on the scale does not represent an equal range of data.

Consider the use of arithmetic and logarithmic graphs in mathematics and science classes.

In what ways does this differ **compared** to how these graphs are used in geography classes?

Research the topics, data or variables used for graphs in those subjects.

VOLCANOES

Volcanoes represent the most visible part of our planet's tectonic activity through spectacular fiery displays and majestic lava flows but they are also a deadly force of nature whose effects on place and space can be seen for prolonged periods of time. Volcanoes are mainly associated with plate margins and, apart from hot spot volcanoes, such as those in Hawaii and Yellowstone, most erupt at constructive and destructive plate margins (see Figure 11.24). (Hot spots are areas in the mantle with unusually hot magma. They normally occur away from plate margins, which results in volcanoes erupting in the middle of crusts, such as Hawaii on the Pacific Plate and Yellowstone on the North American Plate.

WHAT MAKES YOU SAY THAT?

Work with a partner. Use the map in Figure 11.24 to **compare and contrast** the distribution of the Earth's tectonic plates and the global distribution of earthquakes and volcanoes.

Summarize your ideas about the relationship between plate boundaries and volcanic activity in one statement: 'I think that ...'. What makes you say that?

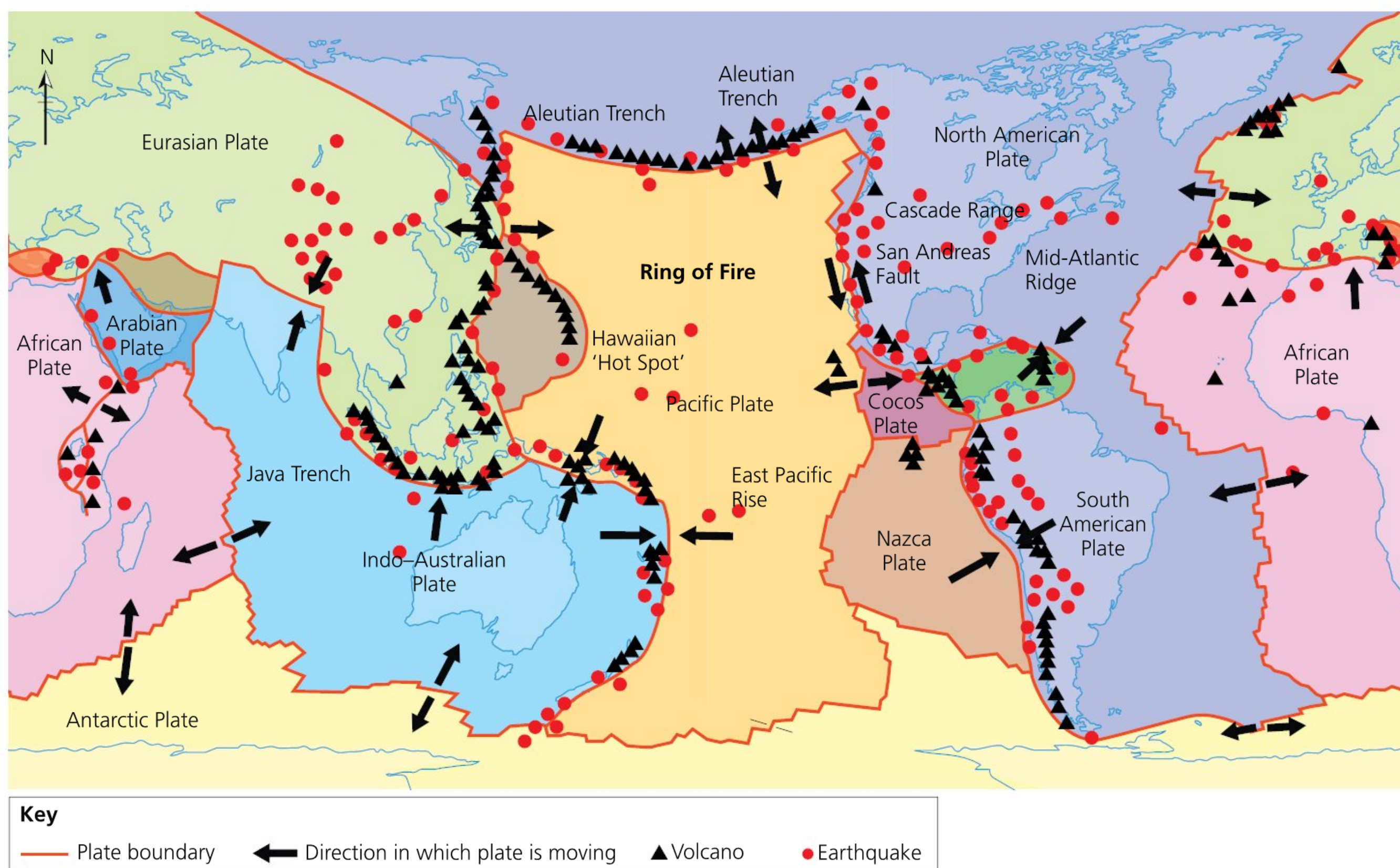


Figure 11.24 The global distribution of volcanoes and earthquakes

ACTIVITY: Volcanic eruption styles

■ ATL

- Communication skills: Negotiate ideas and knowledge with peers and teachers
- Transfer skills: Inquire in different contexts to gain a different perspective

In pairs, look at Figure 11.25, which shows Kilauea, a volcano in Hawaii.

Discuss these questions:

- 1 What is unusual about this photo?
- 2 How would you describe this eruption?

- 3 Using information from pages 250–51, decide the most likely type of lava erupting from this volcano. Why is it pouring out in this way?

Now work with your partner to research online for videos of contrasting styles of volcanic eruption. Answer Questions 1 to 3 again using the video you have chosen.

Discuss what difference the type of lava makes to the styles of volcanic eruptions.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowledge and understanding and Criterion D: Thinking critically.



■ **Figure 11.25** Kilauea volcano erupting

Earlier in this chapter, we discussed the importance of different types of magma in determining how active plate margins can be. The same applies for volcanoes. Along constructive margins, low silica content **basic lava** erupts directly from within the mantle and travels long distances to form large, low-lying, gently sloping shield volcanoes (see Figure 11.26), as in Iceland.

Along destructive margins, the opposite occurs. High silica, viscous **acid lava** travels short distances before cooling, often trapping gases, where pressure increases, making eruptions more violent. The resulting volcanoes are steep sided and tall, such as Mount Fuji in Japan, the archetype of a composite volcano (see Figure 11.26). The erupted material consists of gas, pulverized lava, in the form of volcanic bombs and ash, collapsed lava deposits and, most of all, dust which can travel worldwide. After the 1883 Krakatoa eruption in Indonesia (see Figure 11.27), people across the world witnessed a dust-filled atmosphere for months afterwards and some artists recorded the effect, such as the British painter William Ashcroft, who painted vivid impressions of blood-red sunset skies above northern Europe (see Figure 11.28).

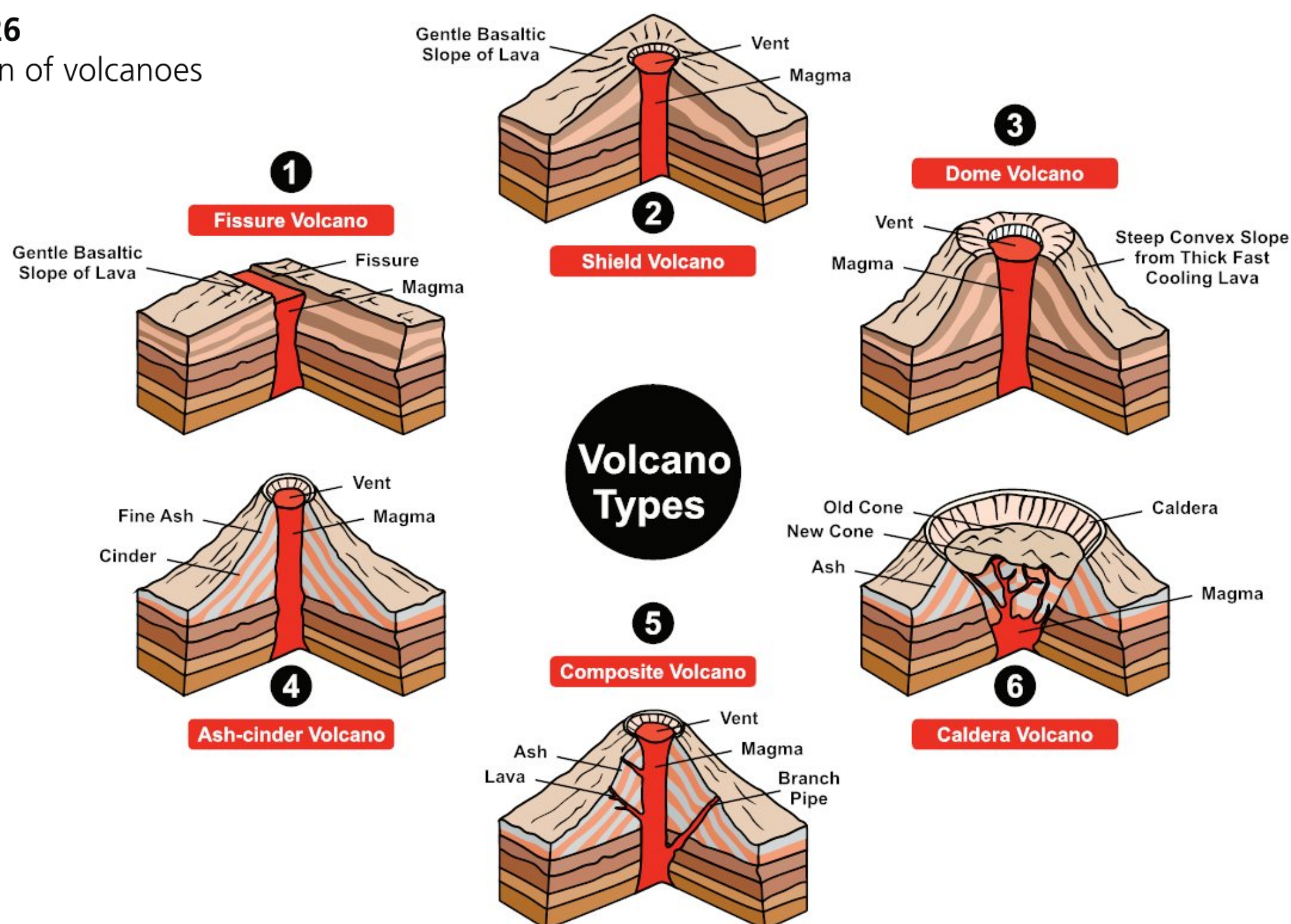


■ **Figure 11.27** The 1883 Krakatoa eruption



■ **Figure 11.28** *Sunset* – a painting by British artist William Ashcroft

■ **Figure 11.26**
Classification of volcanoes



THINK–PAIR–SHARE

Look at the painting by William Ashcroft (Figure 11.28) and reflect on your own about what modern-day geographers and volcanologists can learn from a painting from a different time period. Share your views in pairs and then **discuss** them with the rest of the class.

ACTIVITY: Exploring different types of volcanoes

■ ATL

- Information literacy skills: Access information to be informed and inform others
- Critical-thinking skills: Use models and simulations to explore complex systems and issues
- Collaboration skills: Build consensus

- 1 Using the following website (or a GIS program), study three contrasting volcanoes: Mauna Loa in Hawaii, Mount Vesuvius in the Bay of Naples in Italy and Mount Pelée in Martinique:
www.google.com/maps
Investigate the following characteristics:
 - The volcanoes' diameters. To do this, right click and select *Measure distance*.
 - The volcanoes' slopes. Click on the 3D icon from the map control buttons on the bottom right corner of the map.
 - The land use. Switch between satellite and map views to discover the main human activities on and near the volcanoes.
- 2 As a group, share the findings of your investigation. **Identify** similarities and differences between the three volcanoes.
- 3 As a class, **discuss** the extent to which these volcanoes fit the classification shown in Figure 11.26. Think carefully about the evidence you will use to support your views.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion B: Investigating and Criterion D: Thinking critically.

▼ Links to: Visual art

Many artists have taken their inspiration from natural processes ranging from volcanic eruptions to tsunami events. Similarly, some scientists have studied the effects of past tectonic events on societies by analysing artwork.

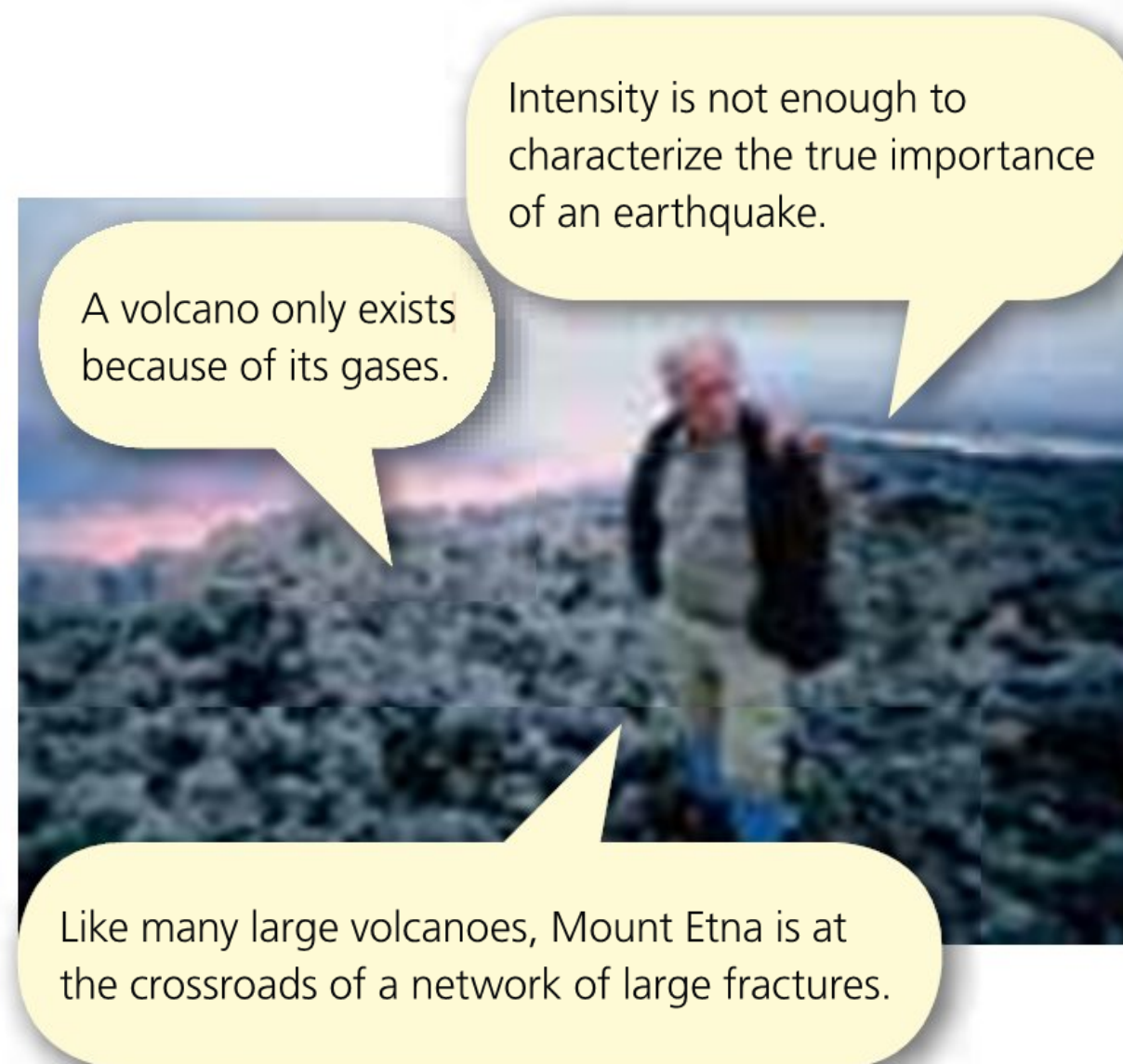
Think about painters you have studied in visual art. Which famous European artists from the eighteenth and nineteenth centuries depicted evocative impressions of violent natural events in their paintings? **Explore** how they were able to create vivid pieces despite not having access to modern-day technologies and not being able to travel to the areas affected by tectonic events.

CLAIM–SUPPORT–QUESTION

Work in groups of four or five.

Take turns to make a claim about volcanoes (an **explanation** or interpretation of some aspect of the topic), then **identify** support for your claim (ideas, concepts or evidence you know that support your claim) and finally ask a question related to your claim (What isn't explained? What new reasons does your claim raise?)

Use some quotes from the French volcanologist Haroun Tazieff to help you.



- **Figure 11.29** French volcanologist Haroun Tazieff
- Now reflect on the activity. What new thoughts do you have about volcanoes?

PRIMARY AND SECONDARY EFFECTS

Earthquakes and volcanoes primarily affect people living within tectonically active areas. When these effects impact places they then become ‘hazards’, which by definition is when a natural process could lead to a negative impact on humans (refer back to Chapter 10). In the rest of this chapter, we will refer to the *effects* of tectonic processes even if in the majority of cases they are in fact *hazards*.

THINK–PUZZLE–EXPLORE

Think: On your own, brainstorm what you already know about the effects of earthquakes and volcanoes and how they depend on plate margins.

Puzzle: In pairs, brainstorm and write down a list of questions you would like to ask about the differences in the effects of earthquakes and volcanoes for the plate margins you know.

Explore: In pairs, research the answers to your questions.

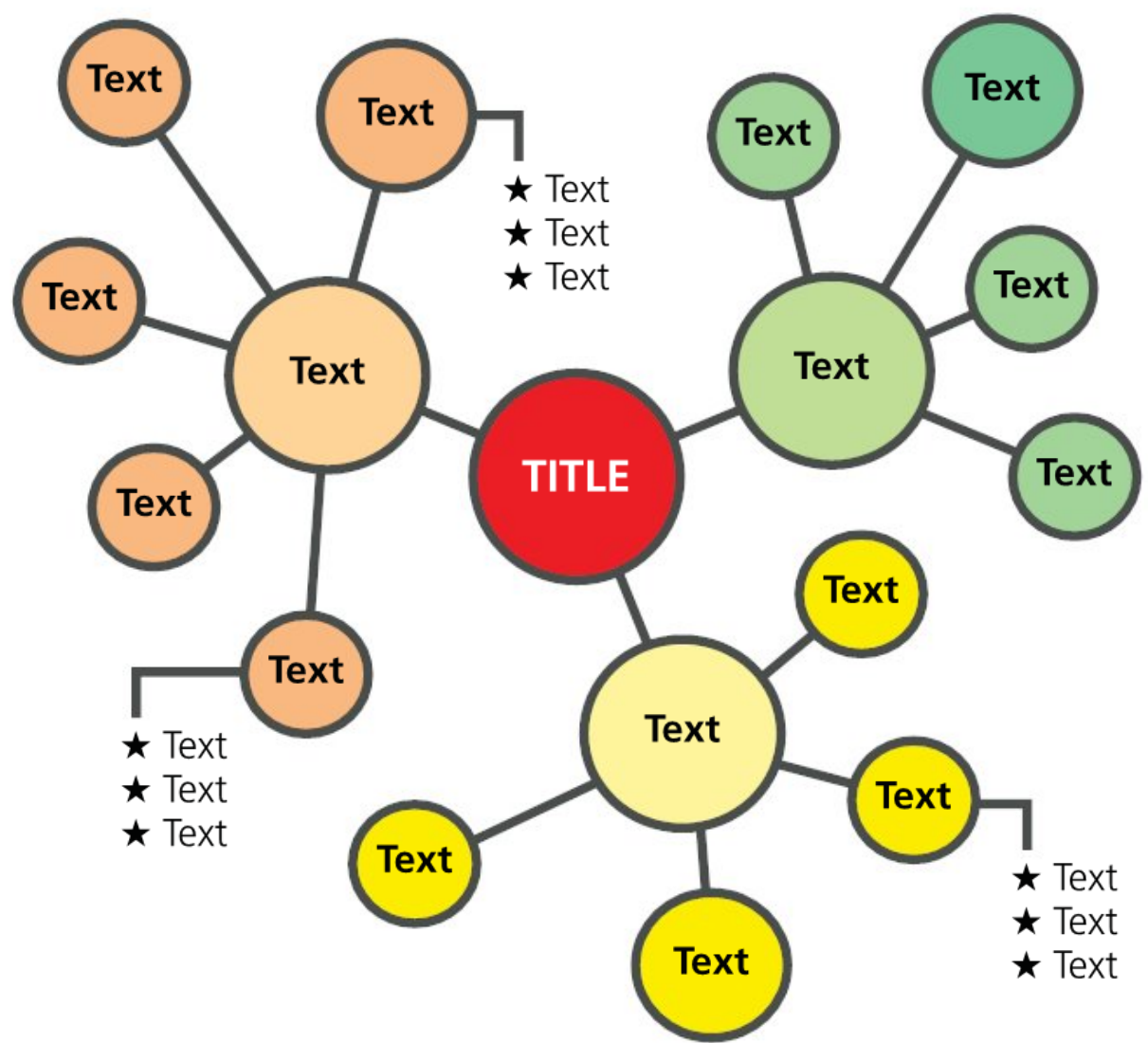
Share your findings with the rest of the class.

ACTIVITY: Primary and secondary effects of tectonic processes

■ ATL

■ Critical-thinking skills: Practise observing carefully in order to recognize problems

- 1 Read the following definitions:
- Primary effects are directly caused by the event or natural process.
 - Secondary effects happen as a result of the primary effect.
- 2 In pairs, review these definitions. Can you think of examples for both earthquakes and volcanoes?
- 3 Draw a mind map to show the effects of earthquakes and volcanoes. Use the mind map template (Figure 11.30) to help you, as well as the photos in Figure 11.31.



■ Figure 11.30 Mind map template

◆ Assessment opportunities

◆ This activity can be assessed using Criterion D: Thinking critically.



Figure 11.31 Effects from tectonic processes: **(a)** L'Aquila earthquake in Italy, 2009, **(b)** tsunami in Japan, 2011, **(c)** clearing up after the Sichuan earthquake in China, 2008, **(d)** Soufrière eruption in Montserrat, 1997, **(e)** ash fall deposits on a car windscreen during the Eyjafjallajökull volcanic eruption in Iceland, 2010, **(f)** lahar (mudflow) deposits on the west flank of Soufrière Hills volcano, Montserrat

SUMMARY OF EFFECTS

Primary effects – earthquakes

The primary effects of an earthquake result from the ground movement and shaking. They include:

- collapsed buildings
- destruction of roads and bridges
- people killed by being trapped in their homes or places of work or education.

Secondary effects – earthquakes

Most of the secondary effects are triggered by high magnitude earthquakes with enough energy to produce:

- landslides, large-scale downslope movements of rocks, soil and sometimes trees
- ground subsidence, when the ground level drops by several metres
- soil liquefaction, when the ground becomes saturated with water and behaves like jelly
- tsunamis, the best known secondary effect, which are often worse than the earthquake itself.

Primary effects – volcanoes

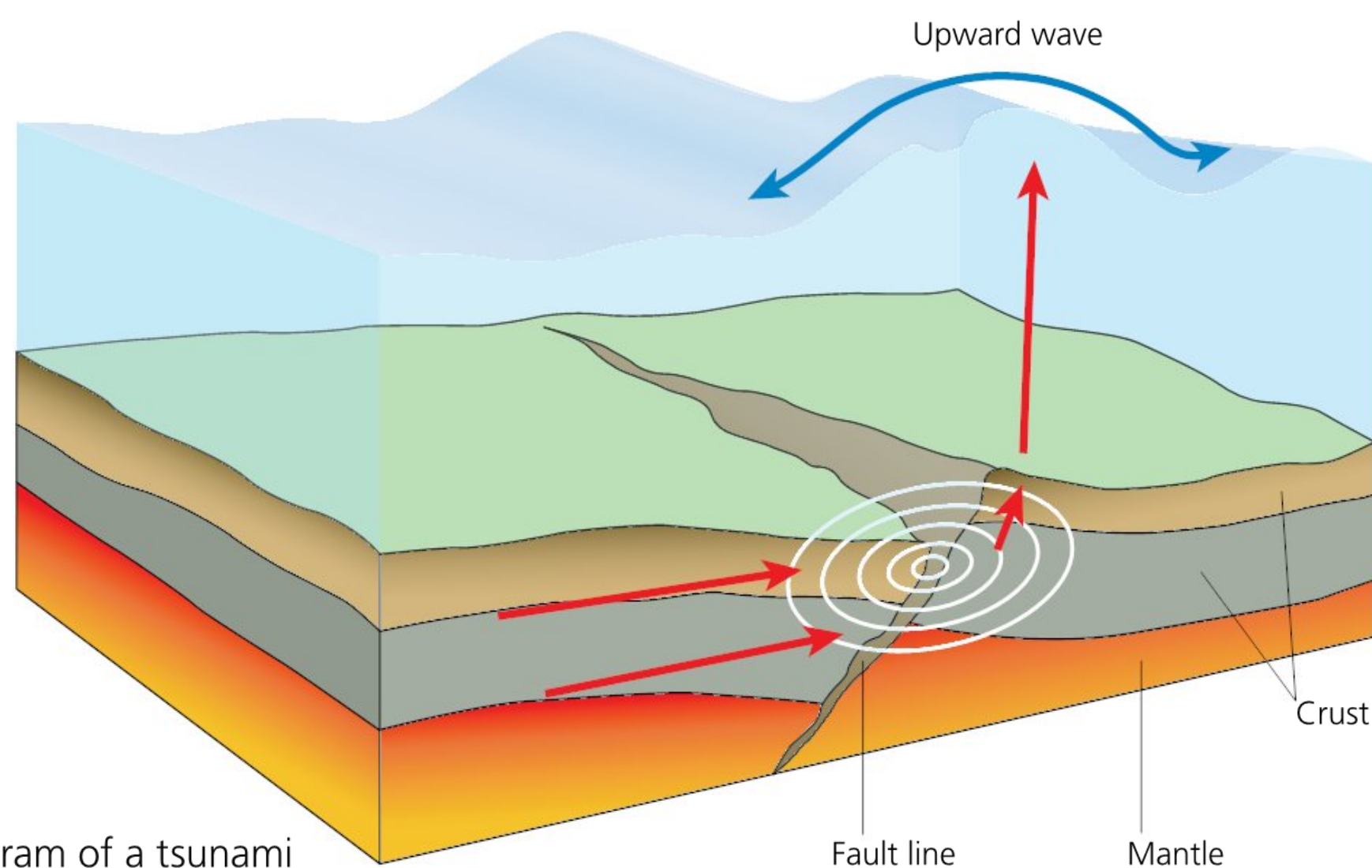
The primary effects of a volcanic eruption are the direct effects of a volcano spewing out lava and a wide range of pyroclastic material. The term 'pyroclastic' comes from the Greek words *pyro* meaning fire and *clastic* meaning fragments or broken pieces. These primary effects are:

- buildings and roads damaged by lava flows and pyroclastic flows
- collapsed buildings due to the weight of ash on roof tops
- people and animals injured or killed by pyroclastic flows
- crops and water supplies contaminated by ash fall
- people and animals suffocated by volcanic gases.

Secondary effects – volcanoes

The secondary effects are the effects that happen indirectly as a result of the primary effects. The secondary effects are:

- mudflows, also called lahars, which occur when water from heavy rainfall or meltwater from snow and ice mix up with ash deposits
- widespread fires caused by lava flows and pyroclastic flows
- volcanic landslides
- tsunamis, following the collapse of a volcano, which result in fast-moving debris crashing into the sea and displacing a large volume of water, thus generating a wave (see Figure 11.32).



■ **Figure 11.32** Diagram of a tsunami

ACTIVITY: A global tour of major earthquake events

■ ATL

- Information literacy skills: Make connections between various sources of information
- Critical-thinking skills: Analyse complex concepts and projects into their constituent parts and synthesize them to create new understanding

What is your project?

You are an experienced field guide putting together a presentation for an educational tour operator planning to run a brand new MYP Geography fieldtrip. Your trip locations must allow students to **investigate** the effects of major earthquake events (including tsunamis) while exploring the MYP concepts of time, place and space.

Make sure your location examples show contrasts in the types of plate margins (conservative, constructive and destructive boundaries) and also differences in levels of development (richer and poorer countries).

What is the format?

You will **present** your findings for at least three major earthquake events by using Tour Builder:

<https://tourbuilder.withgoogle.com/>

Hint

You can find more on how to use Tour Builder at:
<https://tourbuilder.withgoogle.com/about/faq>

Each placemark on your tour should have:

- a clear location name
- the date of the event
- categorized effects (primary and secondary)
- link(s) to give further information about the effects – a video, eyewitness account, interview, article, image, etc. Try to balance this so you do not have too many of one kind of source.

Once your tour is completed and saved, write a supporting document discussing the importance of time, place and space, looking at the range of the effects from your **investigated** earthquakes. You could use the following questions to guide your reflection:

- **Time:** What time of day did it take place? How long did it last? Were there any foreshocks and when did they start? How long were there aftershocks for? Why is this important?
- **Place:** What are the similarities or differences between the different locations? Have your **investigated** places been affected by many earthquakes before or was the event unexpected?
- **Space:** What is the type of plate margin at your location? Did this increase the range of both primary and secondary effects? What other physical factors could have contributed to the effects? Were there any human factors responsible in worsening the effects?

Your report should be 700–1,500 words long.

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion B: Investigating and Criterion D: Thinking critically.

READ–THINK–WONDER

Read the following article and scan for information related to the process of liquefaction: www.theguardian.com/weather/2011/feb/23/new-zealand-christchurch-earthquake-geology

How does the process work? What is the sequence of processes that result in the ground turning into a liquid?

Drawing a diagram to illustrate the process and its impact on buildings and infrastructure may be helpful.

How can the effects be reduced? What is the most important factor that needs to be controlled?

CASE STUDY – MOUNT MERAPI VOLCANIC ERUPTION, INDONESIA

SOURCE A

A searing gas cloud flowed down an Indonesian volcano with a thunderous roar, torching houses and trees and incinerating villagers as they fled Mount Merapi's worst eruption in a century.

Scores of bodies found today raised the death toll to 122 since the volcano's latest volatility began last week.

The explosion overnight hit hardest in Bronggang, nine miles from the crater, which had been designated as a safe zone. Soldiers joined the rescue operations, pulling at least 78 bodies from homes and streets blanketed by ash 30cm deep.

The injured – with clothes, blankets and even mattresses fused to their skin by the heat – were taken away on stretchers.

'The heat surrounded us and there was white smoke everywhere,' said Niti Raharjo, 47, who was thrown from his motorbike along with his 19-year-old son while trying to flee.

'I saw people running, screaming in the dark, women so scared they fell unconscious,' he said from a hospital where they were both being treated for burns. 'There was an explosion that sounded like it was from a war ... and it got worse, the ash and debris raining down.'

More than 150 injured people – with burns, respiratory problems, broken bones and cuts – waited to be treated at the tiny Sardjito hospital, where bodies piled up in the morgue, and two other hospitals. 'We're totally overwhelmed here,' said Heru Nogroho, a spokesman at Sardjito.

Bursts of hot clouds occasionally interrupted aid efforts, with rescuers screaming 'Watch out! Hot cloud!' The danger zone where residents have been ordered to flee was expanded to a perimeter of 12 miles.

More than 100,000 people living along Merapi's fertile slopes have been evacuated to crowded emergency shelters, many by force, in the last week. Some return to their villages during lulls in activity, however, to tend to their livestock.

The government announced an \$11m (£6.7m) programme to buy the cows on the mountain to keep farmers off its slopes, and to provide compensation for animals lost in the eruptions.

Gede Swantika, a state volcanologist, said it was the biggest eruption in at least a century in terms of the amount of volcanic material released. The intensifying eruptions have baffled scientists: dozens of explosions that followed Merapi's initial blast had been predicted to ease pressure behind a magma dome.

In 1994, Merapi erupted over several days, killing 60 people. In 1930, another eruption claimed up to 1,300 lives and destroyed a dozen villages.

Indonesia is also struggling with the aftermath of a tsunami in the Mentawai islands, off Sumatra, in which at least 431 people died last week. Merapi's initial blast occurred less than 24 hours after the tsunami struck, sweeping entire villages into sea.

From the Guardian, 5 November 2010



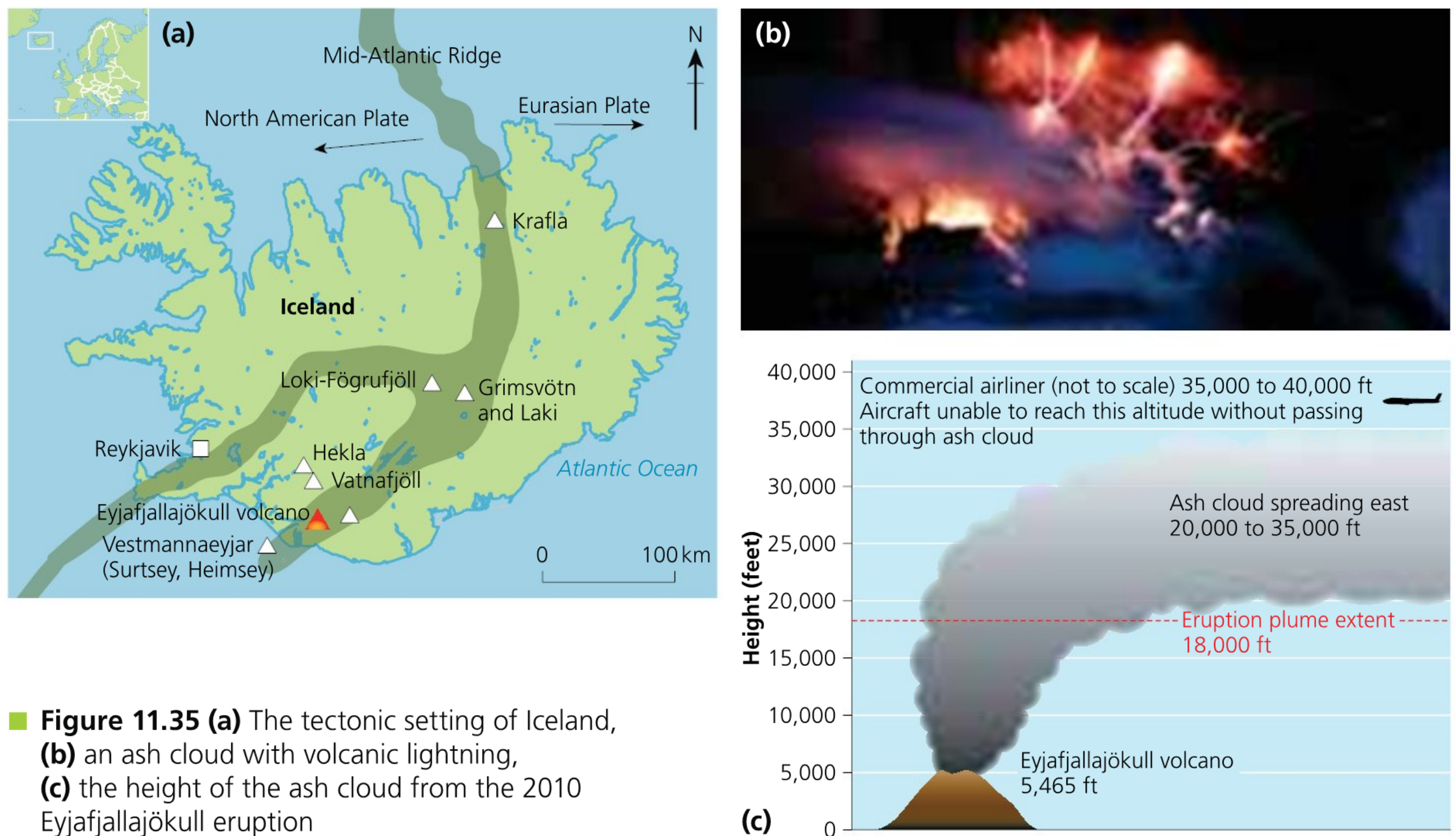
■ **Figure 11.33** Mount Merapi erupting



■ **Figure 11.34** Dead cattle after the eruption

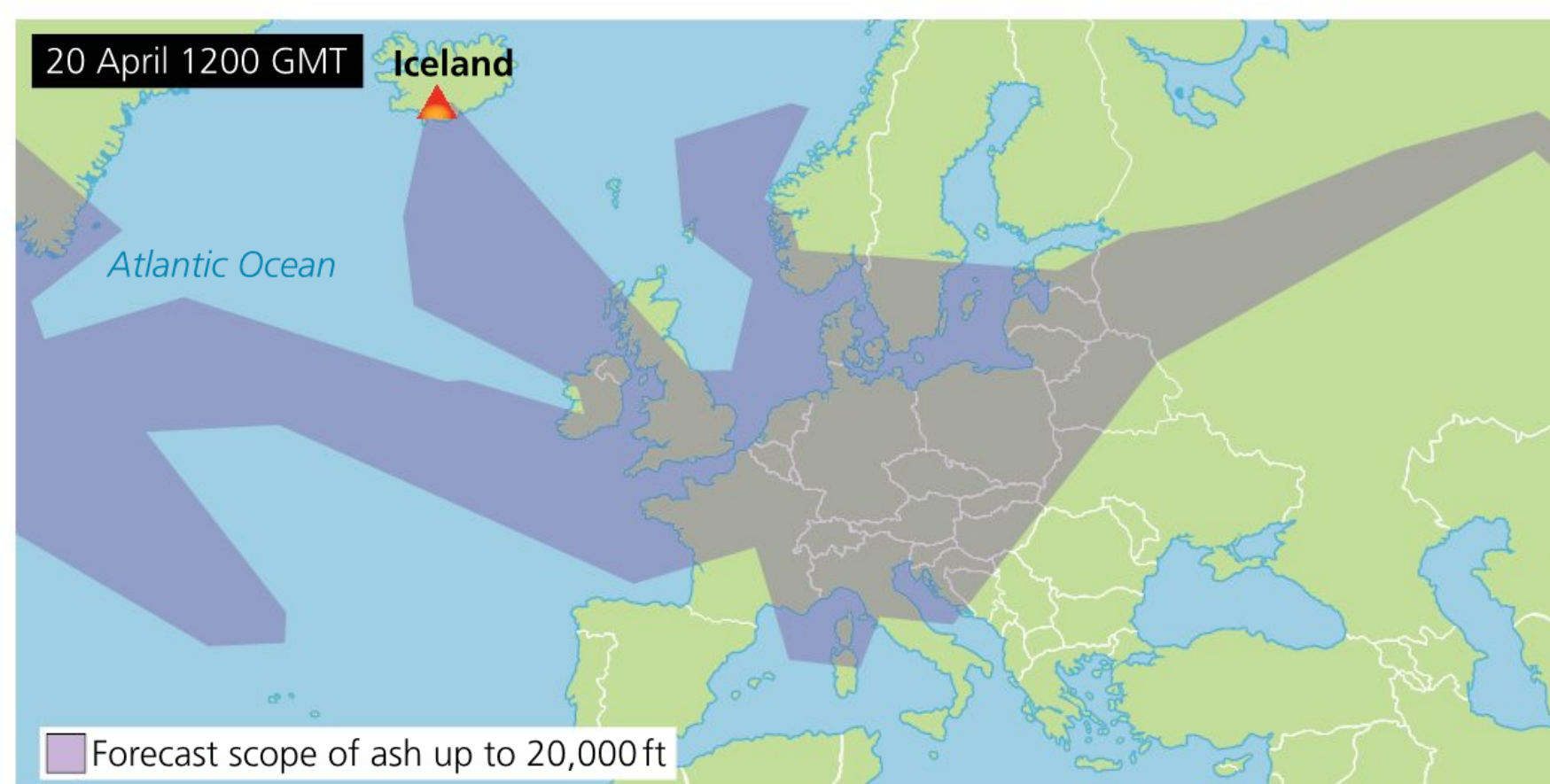
CASE STUDY – EYJAFJALLAJÖKULL VOLCANIC ERUPTION, ICELAND

SOURCE B



■ **Figure 11.35 (a)** The tectonic setting of Iceland, **(b)** an ash cloud with volcanic lightning, **(c)** the height of the ash cloud from the 2010 Eyjafjallajökull eruption

SOURCE C



■ **Figure 11.36** Eyjafjallajökull ash cloud spread on 20 April 2010

SOURCE D

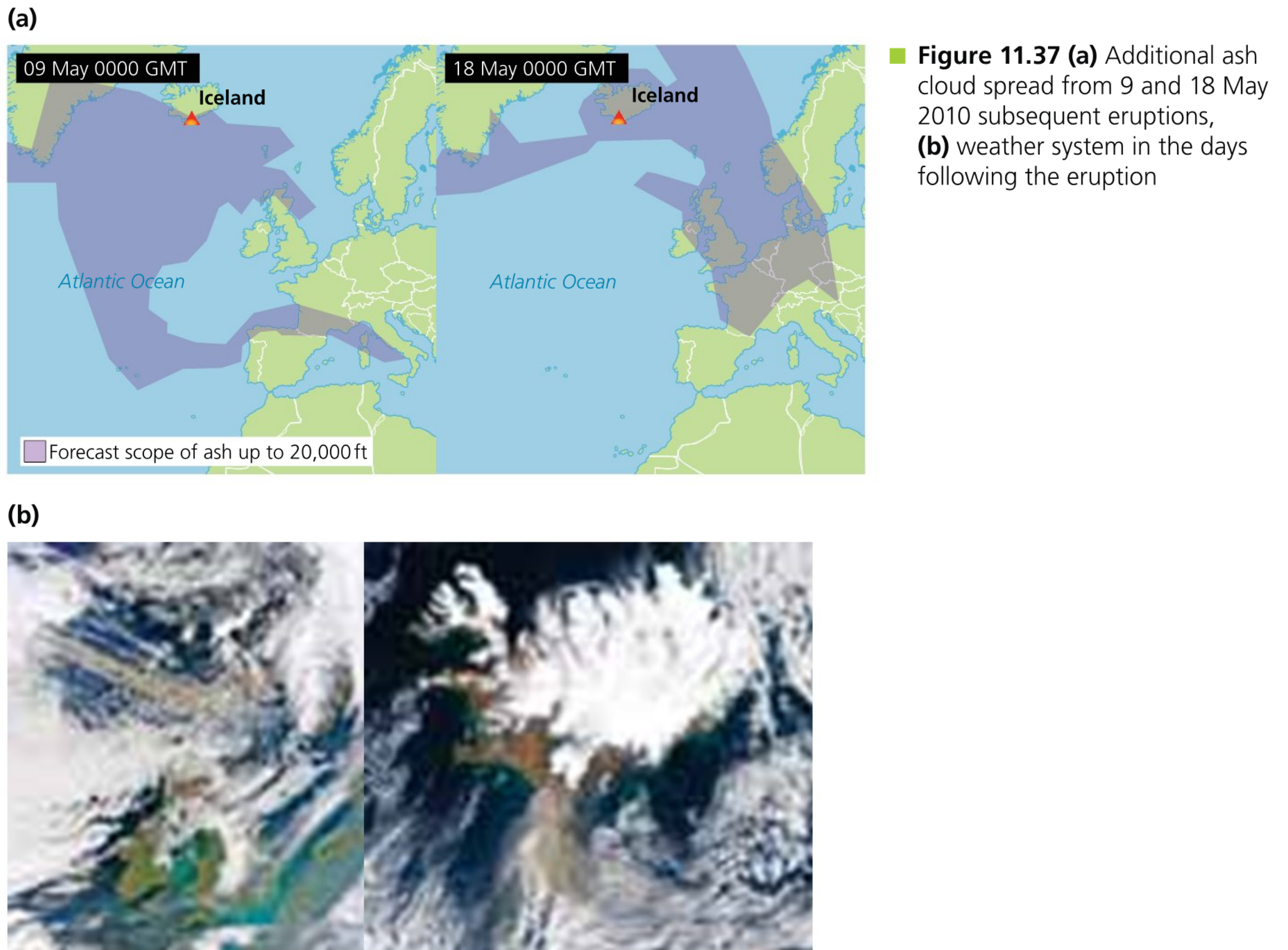


Figure 11.37 (a) Additional ash cloud spread from 9 and 18 May 2010 subsequent eruptions, **(b)** weather system in the days following the eruption

SOURCE E

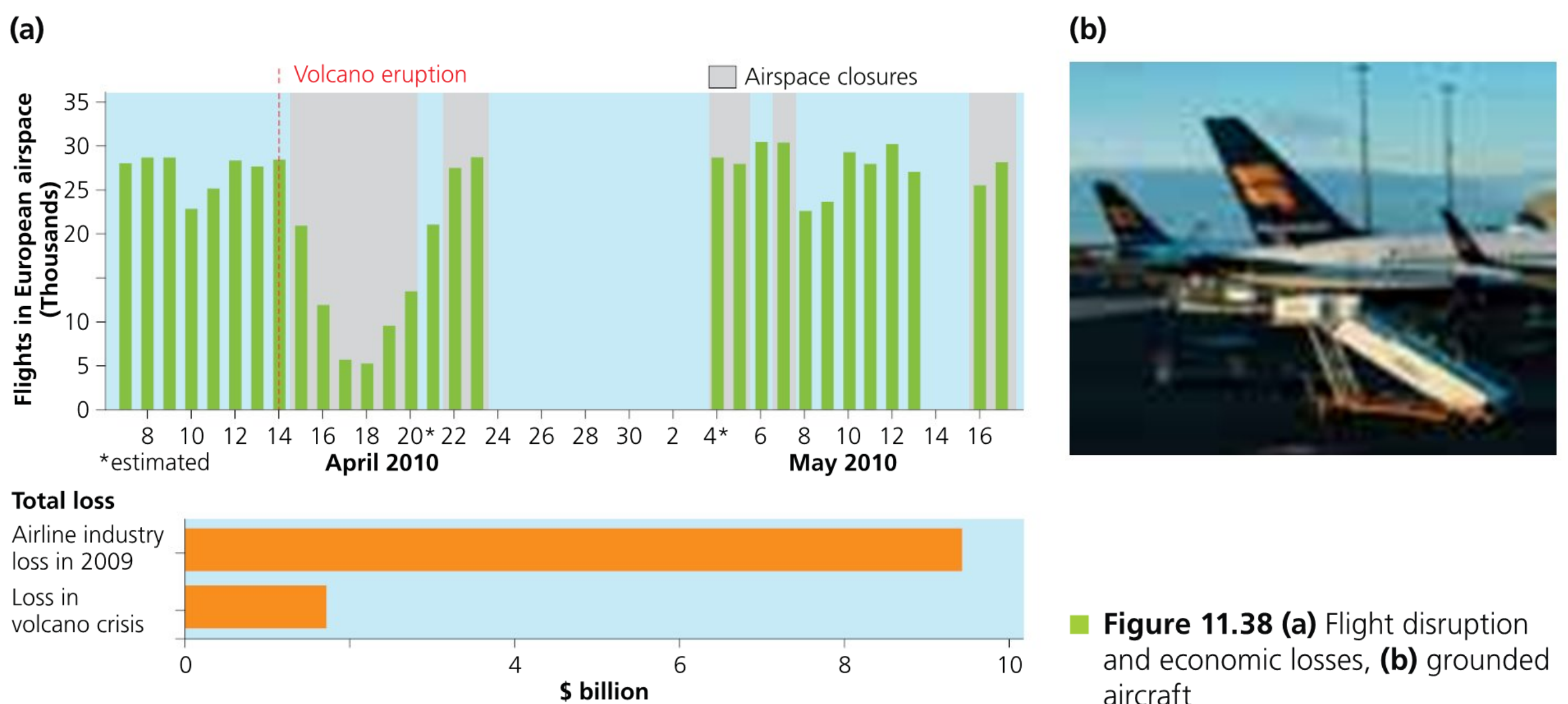


Figure 11.38 (a) Flight disruption and economic losses, **(b)** grounded aircraft

ACTIVITY: Comparing volcanism in different locations

■ ATL

- Information literacy skills: Access information to be informed and inform others
- Critical-thinking skills: Revise understanding based on new information and evidence

- 1 Review the work you have completed on earthquakes.
- 2 Now research information to put together a case study of a volcanic eruption. You could choose your own example from an area you have learnt about or from your home country. You could also **select** the 2010 Mount Merapi eruption in Indonesia (Source A) or the 2010 Eyjafjallajökull eruption in Iceland (Sources B to E) from this chapter. **Analyse** the effects of your chosen volcano. This should include the primary effects as well as the secondary effects.
- 3 Feed back to a group that has researched a different case study. What are the similarities and differences between the case studies? Are the effects generally the same? If not, can you think of reasons why they might be different? Working in pairs or a small group, complete a Venn diagram (see page 157) to **show** where the effects are similar and where they are different.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.

ACTIVITY: The benefits of living near volcanoes

■ ATL

- Critical-thinking skills: Recognize unstated assumptions and bias; Evaluate evidence and arguments; Consider ideas from multiple perspectives

Look at Sources F, G and H.

- 1 Work in pairs. **Analyse** the usefulness of these sources in terms of their origin, purpose, values and limitations. (See page 16 for more on the OPVL technique of source analysis.)
- 2 Using Sources F, G and H and your own knowledge, draft a detailed essay plan to answer the following question: 'Tectonic areas bring more benefits than problems.' **To what extent** do you agree with this statement?

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.

Source G

<https://nypost.com/2017/09/02/tourists-are-flocking-to-volcano-thats-due-for-a-massive-eruption/>

Source H

Source F



■ **Figure 11.39** Nesjavellir power plant, Iceland



■ **Figure 11.40** A farm near Mount Fuji, Japan

Can technology help predict earthquakes and volcanic eruptions in every place?

SCIENTIFIC DISCOVERIES IN THE FIELD OF PLATE TECTONICS

In the sixteenth century, Gerardus Mercator invented the Mercator map projection, which is still used today for Google maps. It allowed the first modern global maps to be drawn and was probably the key innovation that helped British scientist Francis Bacon develop the first plate tectonic theory. Bacon noted that the coasts of South America and West Africa fitted like the pieces of a jigsaw. His observations also relied on the revolutionary innovation of the printing machine, which made maps more widely available for sailors and scientists to use.

More recently, during the twentieth century, plate tectonic theory has developed as a science, based on strong scientific discoveries. Technological developments, many of which were driven by the need to improve wartime technology, were essential in providing much needed scientific evidence.



■ **Figure 11.41** Sir Francis Bacon



■ **Figure 11.42** The Mercator map projection

▼ Links to: History

Search **Lisbon 1755 modern seismology** to **explore** how the major historical event of the 1755 Lisbon earthquake led to the birth of modern earthquake science.

THINK–PAIR–SHARE

Think about the following questions on your own, and then share your thoughts with a partner.

What was the role of technological innovations in improving scientific understanding of tectonic processes? If you had to choose one technological breakthrough, which one would it be?

Justify your choice.

ACTIVITY: The plate tectonics theory – news flash on major scientific discoveries

■ ATL

- Communication skills: Use a variety of media to communicate with a range of audiences
- Information literacy skills: Present information in a variety of formats and platforms

What is your goal?

Your goal is to communicate, as a pair or a small group, a key scientific breakthrough in the field of plate tectonics by a scientist of your choice in the format of a short news flash.

You could choose to research the work of:

- Alfred Wegener
- Maurice Ewing
- Drummond Matthews
- Harry Hess

How will you organize your project?

Task 1: In groups, brainstorm inquiry questions that will help you structure your research and **formulate** an action plan.

Hint

You could use the five Ws – who, what, when, where and why – and how – to guide your research.

Task 2: Research your information, making sure you focus on the main discovery that supports the plate tectonic theory. What is the most striking piece of evidence? Are there any useful visual aids you could add to your news flash?

Task 3: Practise your news flash so its format is suitable for the audience and the timing is right, ideally 2–3 minutes long.

Task 4: **Present** your work either as a pre-recorded short video or audio clip, or as a live performance in class.

Follow-up discussion

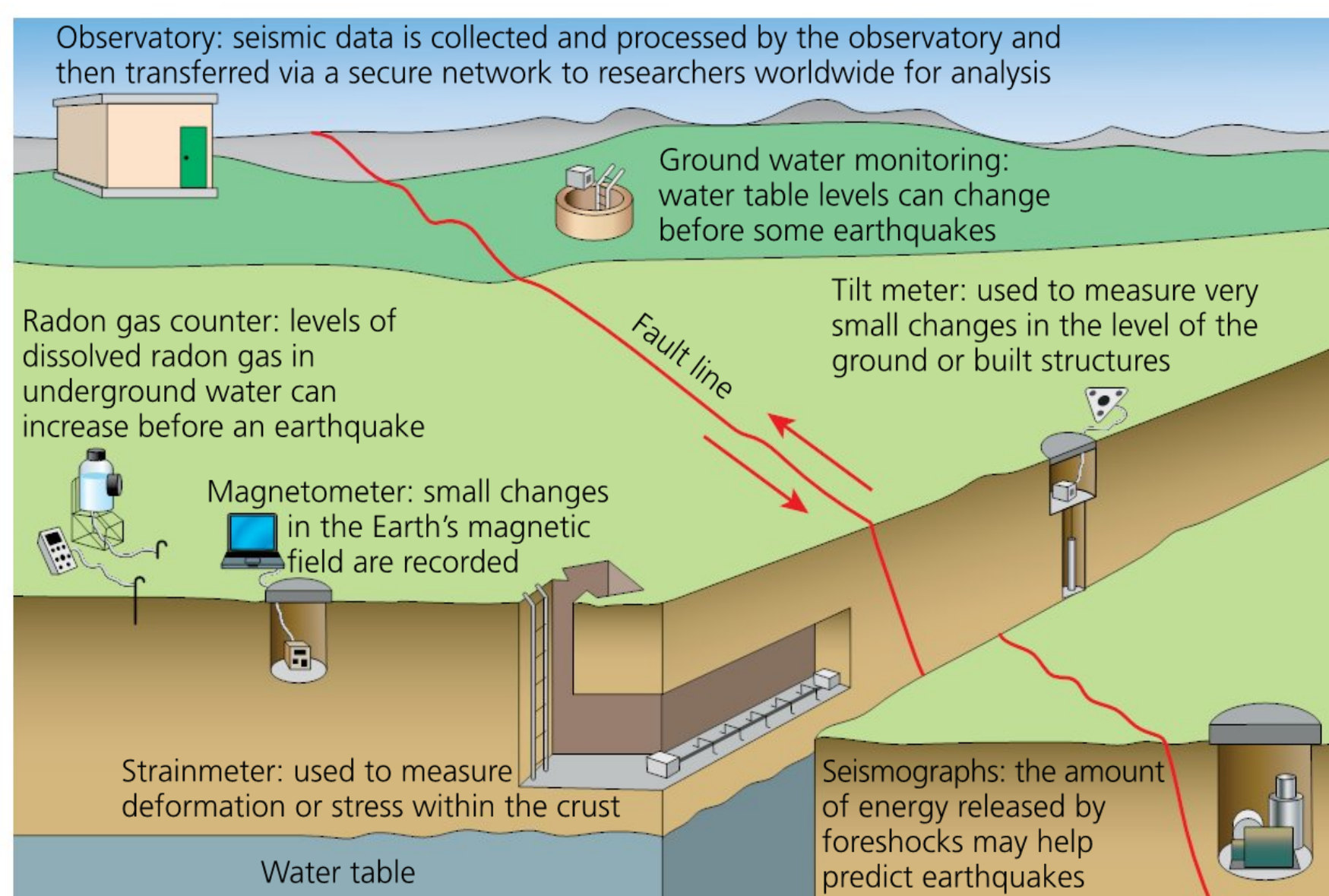
As a class, **evaluate** the key scientific discoveries presented. Which pieces of evidence contributed the most to a better understanding of the plate tectonics theory? **Justify** your decision.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion B: Investigating, Criterion C: Communicating and Criterion D: Thinking critically.

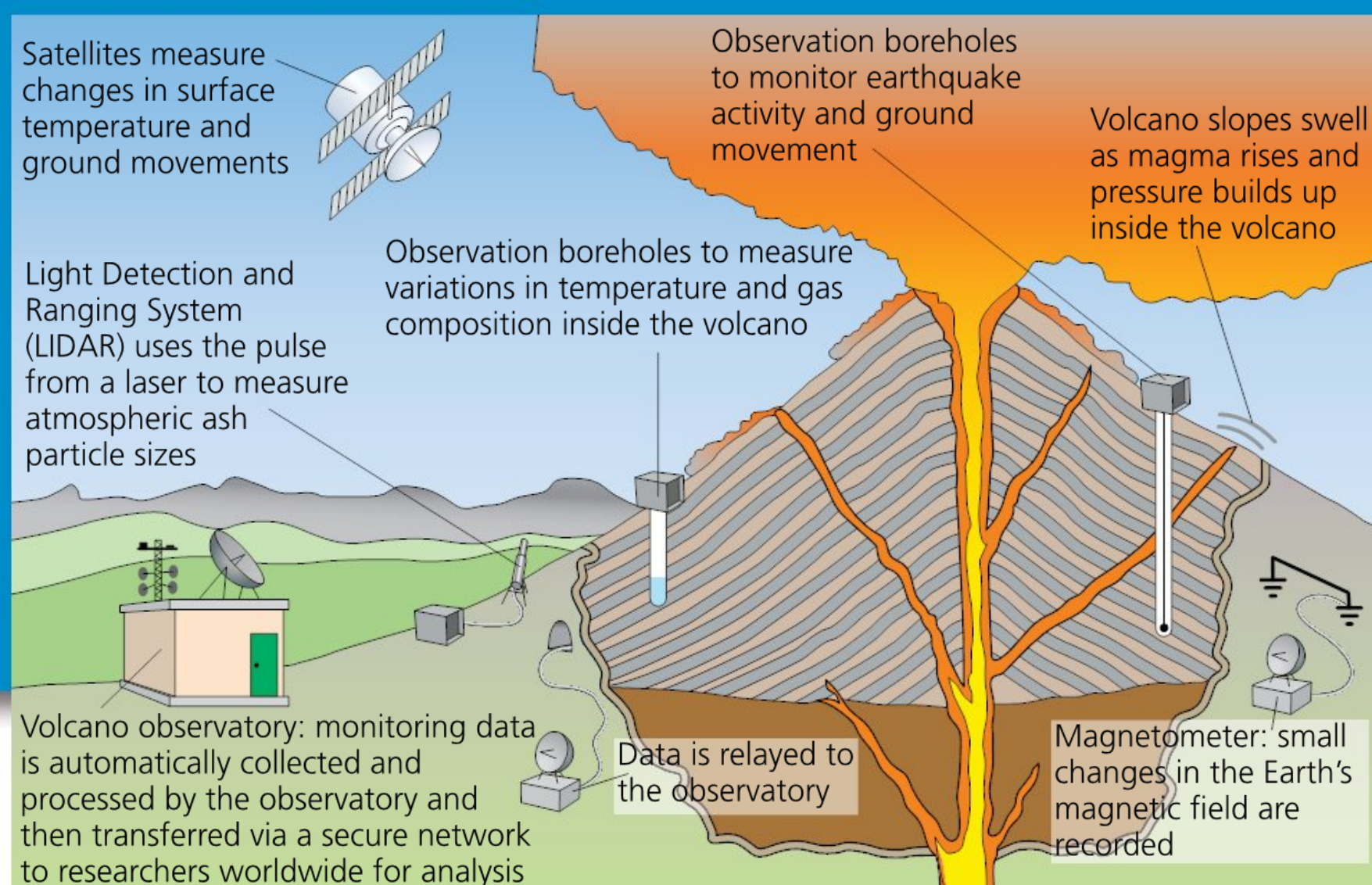
CAN TECHNOLOGICAL INNOVATIONS HELP SCIENTISTS PREDICT TECTONIC EVENTS?

Tectonically active zones are the most studied and monitored regions of the world. The ability to predict both earthquakes and volcanic eruptions has long been a goal of the scientific community. Seismologists are able to identify the location of margins where the crust has locked for a long time, such as on the Anatolian Fault in Turkey (see Figure 11.15) but with the current technology they are not able to say precisely where and when an earthquake will strike.



■ **Figure 11.43** Earthquake monitoring methods

Volcanologists are slightly luckier than their seismologist colleagues as the first warning signs of an upcoming volcanic eruption is usually a series of earthquakes. In April 2010, the Eyjafjallajökull volcano was rattled by thousands of small earthquakes for four months prior to its eruption, which was sufficient time for the authorities to warn the communities living near the volcano. Nevertheless, technological limitations mean that the scale and path of an eruption is always difficult to determine.



■ **Figure 11.44** Volcano monitoring methods

As our statement of inquiry suggests, the scientific response to tectonic processes is certainly determined by time and place.

ACTIVITY: Earthquake and volcano monitoring, then and now

■ ATL

- Creative-thinking skills: Use brainstorming and visual diagrams to generate new ideas and inquiries
- Communication skills: Use a variety of media to communicate with a range of audiences

Design an infographic poster about past and present technologies used for tectonic activity monitoring and prediction. Your infographic should use the format 'Then' and 'Now' which will help to **show** the changing face of the technology over time.

In order to **create** an effective and captivating infographic, follow the guidance below:

- Make it eye catching by using simple and clear diagrams as well as great pictures.
- Include numerical data that really sum up the improvement in the technology. For instance, the number of earthquakes picked up daily by modern instrumentation.
- Remember to keep your text simple and always consider your audience.

Create a gallery of your infographics by displaying them in your classroom.

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion C: Communicating.

DISCUSS

Our inquiry question for this section is 'Can technology help predict earthquakes and volcanic eruptions in every place?' Search online for **USGS prediction** to get an answer from expert seismologists.

Now that you know the answer, **discuss** as a class what strategies would be the most suitable to help prevent loss of life and damage from earthquakes.

What effects do tectonic processes have on people in different contexts?



■ **Figure 11.45** Traders after the 2010 Haiti earthquake



■ **Figure 11.46** Khokana, Nepal after the 2015 earthquake

DISCUSS

Refer back to page 263 about the primary and secondary effects of earthquakes and volcanic processes.

What is the difference between effects and impacts?

Use the Oxford online dictionary to **explore** the meanings of these two related words:

<https://en.oxforddictionaries.com/>

Can you think of examples of effects and impacts from case studies already completed in class?

As we learnt earlier in this chapter, no place in the world is completely safe from tectonic hazards, but some are more prone to earthquakes and volcanoes than others. A significant number of rich countries are excluded from active zones; for example, most of the countries in Europe with the exception of Italy and Greece. Tectonic processes translate into risk, which is defined as an increased likelihood of death through exposure and **vulnerability**. Exposure is high for many developing countries with high population densities that are located in active zones such as the Pacific Ring of Fire. During the Haiti earthquake, the densely populated capital city of Port au Prince was highly exposed as it was only 13 kilometres from the earthquake epicentre. As a country suffering from extreme poverty, corruption, lack of earthquake plans and poorly built infrastructure, Haiti was also vulnerable.

WHAT MAKES YOU SAY THAT?

What is happening in Figure 11.46 and what does it show about the effects of this earthquake?

Are primary effects or secondary effects or both shown in this scene?

What makes you say that?

What impacts would the area suffer from in the short term? What about in the long term?

ACTIVITY: Do tectonic processes have the same impacts in rich and poor countries?

In this activity you are going to investigate the impacts from tectonic processes in richer and poorer countries. Use Figure 11.47 for help in structuring your investigation.

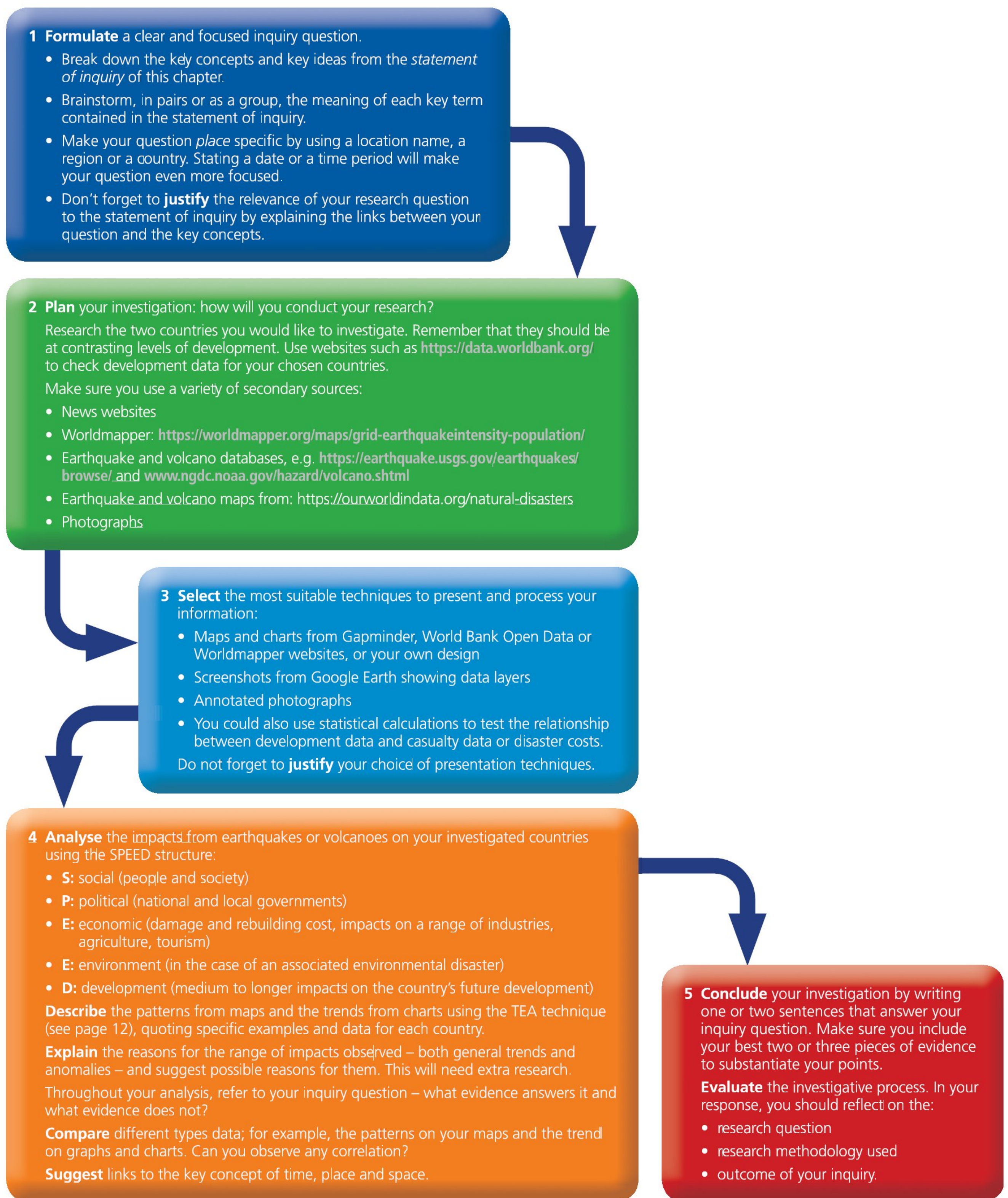
The most important step is to get your inquiry question right. You will need to have it checked by your teacher before starting your investigation.

■ ATL

- Transfer skills: Inquire in different contexts to gain a different perspective
- Communication skills: Structure information in summaries, essays and reports
- Critical-thinking skills: Interpret data

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion B: Investigating and Criterion D: Thinking critically.



■ **Figure 11.47** Investigation process

To what extent can technology limit the impact of tectonic hazards?



■ **Figure 11.48** Diggers removing rubble following the L'Aquila earthquake in Italy



■ **Figure 11.49** People removing rubble by hand following the Haiti earthquake

In Japan, over 35 million people live in Tokyo's megacity. The urban area sits a mere 100 km north of the Sagami ocean trench, which can produce devastating earthquakes and tsunamis. Another 100 km to the south-west lies Mount Fuji, one of the top five most dangerous volcanoes in the country.



■ **Figure 11.50** An earthquake-proof building in Mexico

THINK–PAIR–SHARE

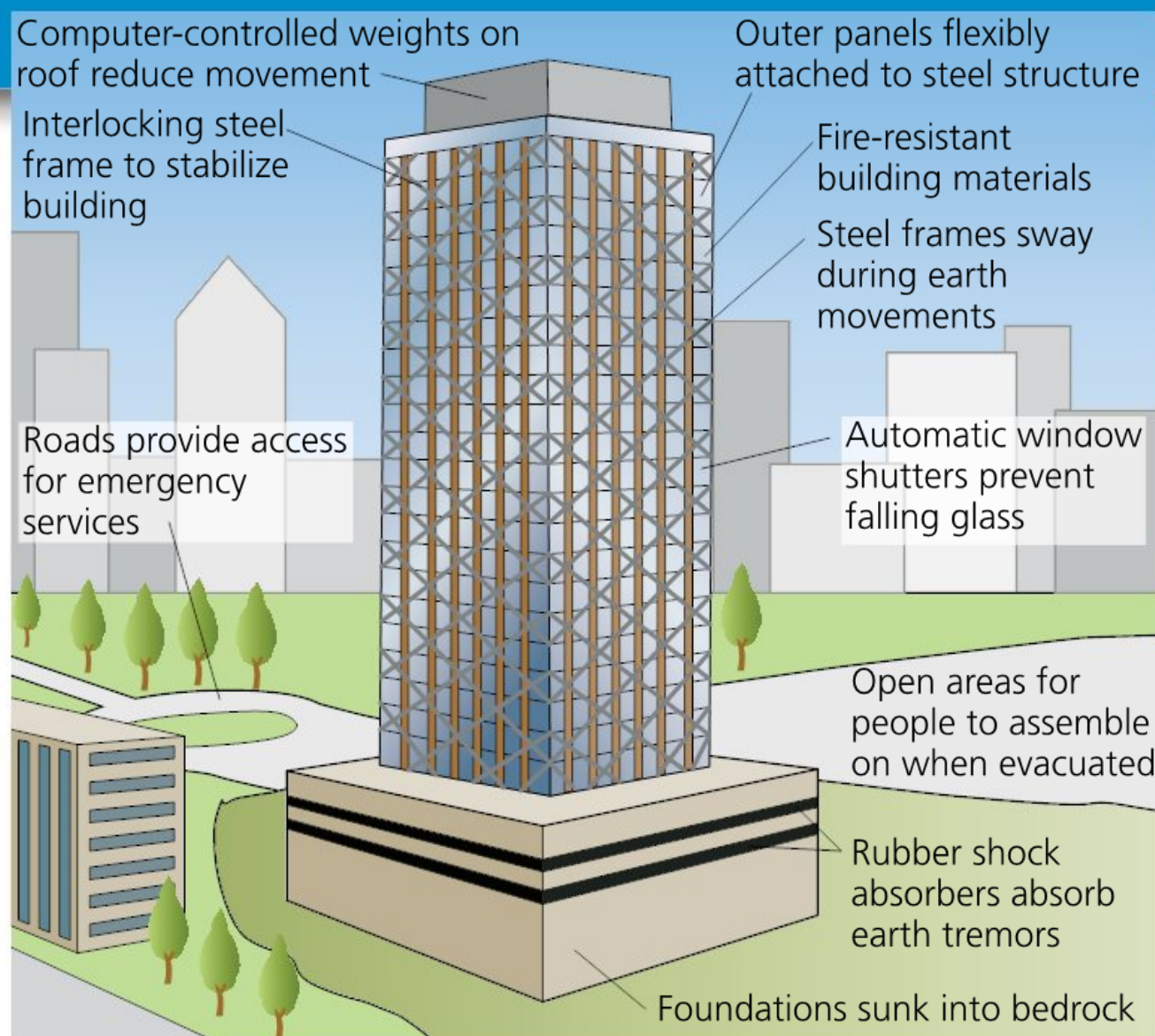
One of the best ways people can prepare for a major earthquake is by putting together a survival kit. **List** a maximum of ten essential items you would put in your kit in the context of a rich country. Be prepared to **justify** your item choices.

Now share your list with a partner and try to come to an agreed list. Then share your agreed list with other pairs.

As a class, **discuss** how suitable your list would be in the context of a poorer country. Which items would you have to remove as they might not be available? Would you be able to assemble a survival kit at all?

It seems that places located in tectonically active zones must have their attractions. The threat from tectonic processes means that a huge amount of effort has been put into research and appropriate technology to reduce the damage when an earthquake or volcanic event does finally happen.

The severity of a tectonic hazard and its impact on humans depends on a combination of factors. The factors linked to the space itself depend on the location of the epicentre and depth of the focus, which are a result of the plate margin and fault zones. The geology (rock type) and the duration of the event will also be determining factors.



■ **Figure 11.51** Earthquake-proofed building technology

But if there is one absolutely crucial factor which can be a matter of life or death, it is the time of the day at which the event occurs. Earthquakes happening when people are at home and asleep tend to be the most devastating. For example, the Great Hanshin earthquake in Japan in 1995 happened at 5.46a.m. and claimed 6,434 lives.

The factors related to place, and therefore linked to levels of development and hazard perception, are being addressed in part by the design of buildings and infrastructure (see Figure 11.51).

DISCUSS

To what extent do you agree with the statement: 'Earthquakes don't kill, buildings do.'

Discuss with the rest of the class.

The efficiency of the emergency services and the community's degree of preparedness is also relevant. Geographical Information Systems (GIS) (see Figure 11.52), which can inform emergency services of risk areas and the magnitude of an event, can help to modify vulnerability by lessening the potential impacts from a tectonic event. Overall, places with sound economic and social structures tend to have a better ability to respond to and recover from a tectonic **disaster**



■ **Figure 11.52** Geographic Information Systems (GIS)

ACTIVITY: Technology and disaster relief

■ ATL

- **Information literacy skills:** Use critical-literacy skills to analyse and interpret media communications
- **Critical-thinking skills:** Evaluate evidence and arguments

After reviewing the information on the role of innovations in limiting hazards from tectonic processes on pages 271–72, **evaluate** the role of new technologies in the response to natural disasters caused by tectonic activity.

You may find this article useful: www.theguardian.com/global-development-professionals-network/2017/jan/25/the-future-of-technology-in-disaster-response

Your extended response should be about 700 words long and should follow the structure below:

- **Strengths of technology use in hazard response**
- **Limitations of technology use in hazard response**
- **Overall appraisal or judgement on the role played by technology in disaster relief**

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.

! Take action: Effective response to earthquake events

■ ATL

- Information literacy skills: Collect and analyse data to identify solutions and make informed decisions
- Media literacy skills: Seek a range of perspectives from multiple and varied sources

What is your goal?

- ! You will be taking the role of one stakeholder in the decision-making process of agreeing on the best responses to earthquake hazards in a poor country of your choice.

How will you achieve this?

- ! Get into groups of five. Each member should take one of the following roles, as part of a disaster management task force:
 - ◆ a government official
 - ◆ an emergency worker
 - ◆ a Non-Governmental Organization (NGO) volunteer
 - ◆ a civil engineer
 - ◆ a local residents' association representative.
- ! Following the aftermath of a recent disaster, concerns have been raised by different groups of people in your region and it is your job as a member of the task force to agree on the best management response for future similar tectonic events. The main issues are:
 - 1 Warnings sent out prior to the event were either partly ignored by the population or did not reach everyone in the region.
 - 2 The relief effort was not effective and many lives were lost due to delays in reaching the least accessible affected areas.
 - 3 There were concerns regarding the quality and design of buildings and infrastructure. Socio-economic disparities in the region may have affected the chances of survival.
- ! Read through the issues and identify the views and concerns of your role.



■ **Figure 11.53** Port au Prince, Haiti after the 2010 earthquake

- ! Research online to find out about the [Haiti earthquake 2010](http://news.bbc.co.uk/2/hi/in_depth/americas/2010/haiti_earthquake/default.stm). You could start by reading this case study: http://news.bbc.co.uk/2/hi/in_depth/americas/2010/haiti_earthquake/default.stm

Debate

- ! In your group of five, discuss the three issues and the opinions of each role. You must come to a decision for each issue, suggesting the best response for future earthquake events. Remember, the task force must come to an agreement that shows understanding of different views and needs.

Reflection

- ! Reflect on your final decision as a group. Discuss the following questions with the rest of the class:
 - ◆ Which role had the best solution?
 - ◆ Who used the best evidence?
 - ◆ Which role or solution would be the most successful in the short term?
 - ◆ Which role or solution would be the most successful in the long term?

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion B: Investigating, Criterion C: Communicating and Criterion D: Thinking critically.

DISCUSS

Watch this TED talk video: https://youtu.be/b98lw_AeGQg

What change do you think is the most important following an earthquake like that in Haiti in 2010: use of new technology or education of local communities?

Reflection

In this chapter, we have **described** the global distribution of tectonic features and **explained** how different plate margins result in a range of tectonic processes. We have **analysed** how tectonically active areas offer both opportunities and challenges. We have **investigated** different volcanoes and earthquake zones using geospatial technology. We have **outlined** the role of innovations in making hazard prone areas safer and **summarized** the impacts from earthquakes and volcanoes on communities around the globe. We have **taken action** to find the most appropriate ways to respond to tectonic hazards in poor countries.

Use this table to reflect on your own learning in this chapter.					
Questions we asked	Answers we found	Any further questions now?			
Factual: What causes tectonic activity? What happens during an earthquake and a volcanic eruption?					
Conceptual: What effects do tectonic processes have on people in different contexts?					
Debatable: Can technology help predict earthquakes and volcanic eruptions in every place? To what extent can technology limit the impact of tectonic hazards?					
Approaches to learning you used in this chapter:	Description – what new skills did you learn?	How well did you master the skills?			
		Novice	Learner	Practitioner	Expert
Collaboration skills					
Communication skills					
Creative-thinking skills					
Critical-thinking skills					
Information literacy skills					
Media literacy skills					
Transfer skills					
Learner profile disposition	Reflect on the importance of being a good inquirer for your learning in this chapter?				
Inquirer					

12

Can humans fix the damage they caused?



- We have the **power** to **change** our **future impacts** on the planet by using appropriate **scientific and technical innovations**.

CONSIDER THESE QUESTIONS:

Debatable: To what extent is GIS a tool for sustainability and future planning? What must be considered when managing the population of a country? Can urban areas ever be managed sustainably? Can humans use technology to counter the impact of their activities on water systems? How can we meet our global consumption levels in the future? Is it possible for management of biomes to be sustainable and equitable? Do the positive effects of globalization outweigh its negative effects? To what extent does tourism aid equality in a country? Why is it so difficult to have a global sustainable response to climate change? Should hazard warning systems be equally available to all? To what extent can technology limit the impact of tectonic hazards?

Now **share and compare** your thoughts and ideas with your partner, or with the whole class.

○ IN THIS CHAPTER, WE WILL ...

- **Find out** how scientific and technical innovation might help us to solve global social, economic and environmental issues.
- **Explore** the different impacts of human activity in contrasting places.
- **Take action** to raise awareness of global issues and bring about change with scientific and technical innovation.

■ These Approaches to Learning (ATL) skills will be useful ...

- Communication skills
- Creative-thinking skills
- Critical-thinking skills
- Information literacy skills

● We will reflect on this learner profile attribute ...

- Principled – we will consider the consequences of our actions for the world that we will inherit in the future.



■ **Figure 12.1** Sea Level Rise Viewer, a GIS that allows users to see how a rise in sea level might affect their coastal communities in the USA, National Oceanic and Atmospheric Administration

◆ Assessment opportunities in this chapter:

- ◆ **Criterion A:** Knowing and understanding
- ◆ **Criterion B:** Investigating
- ◆ **Criterion C:** Communicating
- ◆ **Criterion D:** Thinking critically

KEY WORDS

consumption
systems
technology

This final chapter is organized differently from the previous ones. The activities in the pages that follow will allow you to consider ways in which our understanding of people, places and processes has brought about change in the world or may continue to do so in the future. There is one activity for each debatable question, and some of them are relevant for other global contexts, too. The activities will require you to apply understanding from earlier in this book in new ways and to make connections between the places and spaces we have explored. They may also provide you with opportunities to apply understanding from other MYP subjects you study, and the new understanding you make will help you to see those other MYP subjects in a different light. Many of the activities have an action element and will provide a springboard for service learning opportunities that take your MYP Geography programme out of the classroom and into the real world, to make a difference.

To what extent is GIS a tool for sustainability and future planning?

ACTIVITY: Analysing patterns and trends in the distribution of major tropical cyclones

■ ATL

- Critical-thinking skills: Identify trends and forecast possibilities

Work in pairs.

View the online version of Figure 12.2 showing the global distribution of major cyclones: <https://arcg.is/1fmnXH>

Interpret the map by completing the following tasks:

- 1 **Analyse** the key to ensure you understand the different types of information shown on the map.
- 2 **Describe** the pattern of tropical cyclones using the TEA technique (refer to page 12 for how to describe patterns on maps). Use the '+' or '-' buttons to zoom in or out on different cyclone-prone regions.

3 In pairs, **discuss** the following:

- **Suggest** reasons for the fact that cyclone data from the 1920s are only visible in the Gulf of Mexico.
- What can you **deduce** from the fact that there are fewer tropical cyclone tracks in the Indian Ocean compared to the Gulf of Mexico?
- What does this tell you about technological innovations?
- **Assess** the values and limitations of using GIS to monitor and forecast the paths of tropical cyclones.

Justify your points with reference to specific regions, wind speed and years.

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion D: Thinking critically.



■ **Figure 12.2** Major global cyclones from 1924 to 2014, map layer on ArcGIS Online

What must be considered when managing the population of a country?



■ **Figure 12.3** Managing the population

ACTIVITY: Who controls the population?

■ ATL

- Communication skills: Structure information in summaries, essays and reports
- Critical-thinking skills: Draw reasonable conclusions and generalizations

You are writing for a population magazine about the issue of government control policies. You will be focusing on one country, with either an ageing population or a youthful population.

You should do the following:

- Give the location – a map of the country, showing main towns and population distribution.
- Explain the general causes of the ageing or youthful population.
- Give a brief history of the birth and death rates and the rate of population growth in the country.

- Annotate a population pyramid with notes explaining why it is a youthful or ageing population, using population statistics, such as crude birth rate, crude death rate and fertility rate, as evidence.
- Explain the consequences of an ageing or youthful population for the country.
- Explain what the government has done to address these consequences, or if it has not done anything, explain what you think it should do.
- Do you think it is the responsibility of the individual or the government to manage fertility in countries that have ageing or youthful populations? Justify your answer.

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding, Criterion B: Investigating, Criterion C: Communicating and Criterion D: Thinking critically.

Can urban areas ever be managed sustainably?

ACTIVITY: Research into sustainable cities – develop your own sustainable city

■ ATL

- Creative-thinking skills: Create novel solutions to authentic problems

You have been asked to **develop** a blueprint for a sustainable city for the twenty-first century.

You have been asked to research and plan a report on how you would create a sustainable urban area.

You will need to consider and **comment** on the following:

- Housing for all
- Public and private transport
- Energy use
- Water
- Waste disposal
- Carbon neutral

Create a map of the urban area (you can use a simplified version such as a land use model).

Choose one of these methods to **present** your city:

- Write a report showing your ideas.
- Prepare a presentation on a PowerPoint or Prezi.
- Design the urban area either physically, or on the computer.

These websites will give you some ideas of what cities around the world are doing:

- www.climaterealityproject.org/blog/five-sustainable-cities-making-difference-planet
- <http://blogs.worldbank.org/sustainablecities/>
- www.undp.org/content/undp/en/home/sustainable-development-goals/goal-11-sustainable-cities-and-communities.html
- <http://sustainablecities.net/>

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding, Criterion B: Investigating, Criterion C: Communicating and Criterion D: Thinking critically.



■ **Figure 12.4** Examples of sustainable projects

! Take action

- ! Promote the Sustainable Development Goal 11: *Sustainable cities and communities* in your school. You could look at an issue near your school, or even in your school, or look at issues around the world. You could link the goal with other goals, for example, plastic in the oceans for *Life below water* (Goal 14) and urban waste, or energy use in your school community, for *Climate action* (Goal 13).

Can humans use technology to counter the impact of their activities on water systems?

ACTIVITY: Rivers decision-making exercise

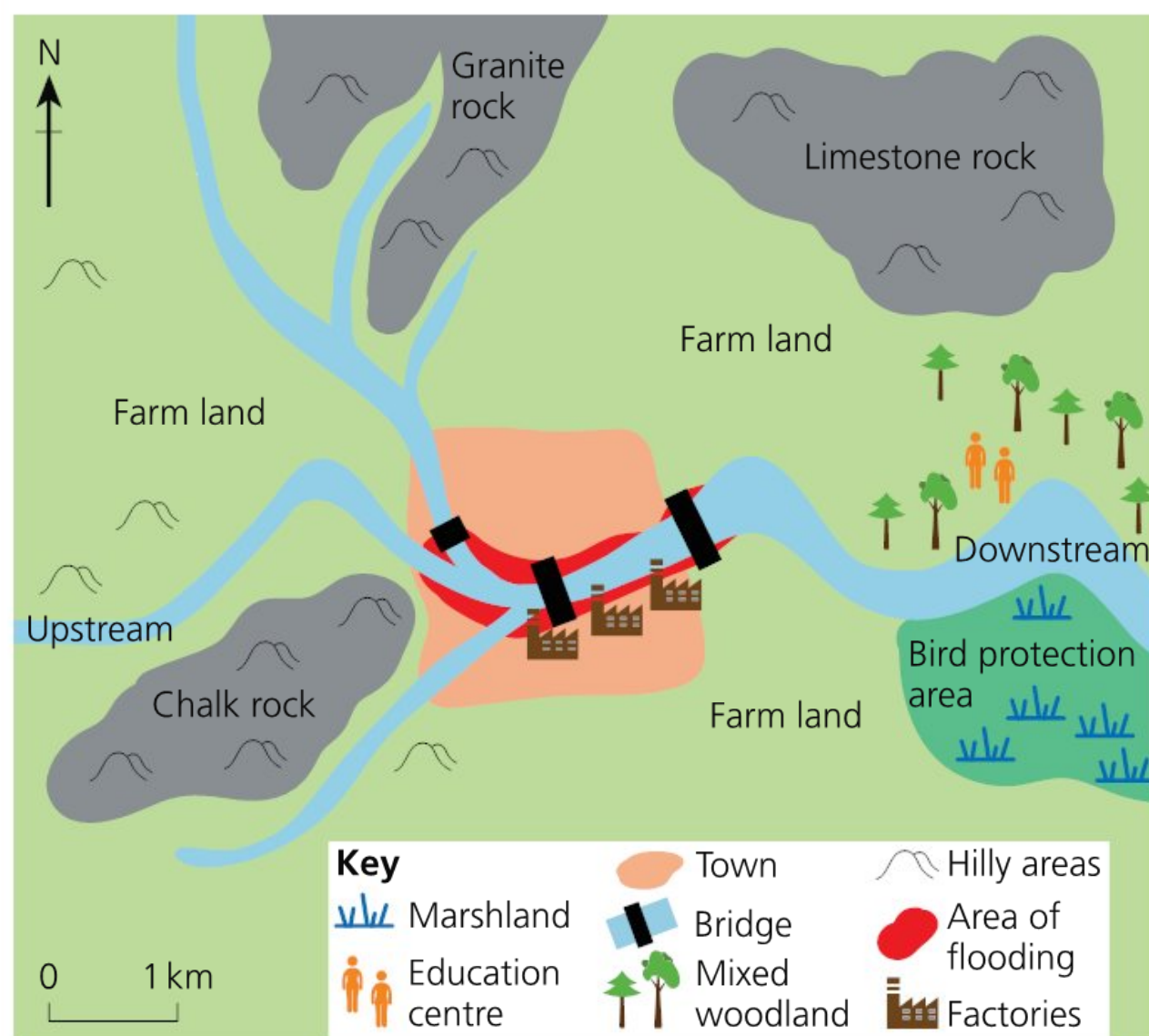
■ ATL

- Communication skills: Organize and depict information logically

You have been asked by the local government to write a report on what should be done to an area that is flooding.

Many people live in this area, and there are large factories that have been built next to the river. These factories are the main source of income for most people living here. However, many rare birds live downstream. They rely on the river for breeding and many people come to see these rare birds. It is also a popular area for children to visit the natural environment.

The map in Figure 12.5 shows the area.



■ **Figure 12.5** Map of river area

You have to decide on a method, or methods, to use to reduce the flooding but to protect the area's natural habitats.

Choose from the following:

- Dams and reservoir
- Embankment
- River straightening (channelization) and dredging
- Flood relief channels
- Flood warnings and preparations
- Flood zoning
- Afforestation/reforestation

Your report must contain:

- A map of the location. If you are using a computer to compile your report, you will need to hand draw the map and scan it in. Include a description of the main features.
- A description and cost of the flood prevention methods.
- A table showing the main stakeholders you have interviewed and their views on what flood prevention method they would like to see.
- A decision on what should be done, with an explanation that you will give to the stakeholders. You have the final word, but you should try to make sure you protect the environment and keep people safe.
- An answer to the debatable question: Can humans use technology to counter the impact of their activities on water systems?

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding, Criterion B: Investigating, Criterion C: Communicating and Criterion D: Thinking critically.

How can we meet our global consumption levels in the future?



■ **Figure 12.6** Vegetables being harvested from a rooftop garden

ACTIVITY: It is all down to us!

■ ATL

- Critical-thinking skills: Evaluate evidence and arguments
- Communication skills: Use a variety of media to communicate with a range of audiences

Investigate an issue linked to Chapter 5. The statement of inquiry is: Individual decisions about consumption can have global impacts; we need to act to change production for a more sustainable world.

Your issue must be related to how, as individual consumers, we can make a difference in the way we consume everyday items. Think about how many out-of-season fruits and vegetables we buy or why some garments bought on the high street or online are so cheap. Decide which product you will **investigate** in terms of its production and consumption, and associated impacts and possible solutions.

You could **present** your findings to the rest of your class or write a report to share with others.

Conduct your inquiry as follows:

- **Formulate** a relevant research question based on your chosen issue.
- **Create** an action plan.
- **Research** your secondary information. You may also want to collect primary information depending on your topic location and scale.
- **Identify** relevant key concepts and understandings. After you have completed your background research, using a range of sources, **identify** the key understandings related to your topic. There is no set number of key understandings to **explore**. You need sufficient information to communicate the key understandings in a 5- to 10-minute presentation or a 700-word report. You must catalogue and cite all of your sources of information.
- **Evaluate** the investigation process:
 - Reflect on your research methods and action plan.
 - **Explain** why the key understandings you **selected** are important.
 - **Suggest** how you could improve inquiry process.

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion B: investigating, Criterion C: Communicating and Criterion D: Thinking critically.

Is it possible for management of biomes to be sustainable and equitable?



■ **Figure 12.7** Sustainable logging

ACTIVITY: My own management plan

■ ATL

- Communication skills: Use appropriate forms of writing for different purposes and audiences

The editor of your school's magazine is organizing a special online edition entitled 'How can we share our world?' They want you to write a special Individuals & Societies and Science interdisciplinary article. You have been asked to write an article to **explain** how the management of a particular biome could be more sustainable than what has happened or is happening now in that area.

In your article, you must use one real-world example of a management in a biome of your choice and how you would make it more sustainable and equitable. You can use this article for your own school magazine or blog to raise awareness.

Here are some examples of what has occurred in the past or is happening now:

- Pipeline development in Alaska
- Fracking in the UK

- Mining in Australia at the Great Barrier Reef
- Poaching in the savanna grasslands of Kenya and Uganda

In your article, you should include the following:

- Location of your biome
- An image that represents the issue of what is happening or has happened in your area
- General information about the processes in the biome
- A description of one real-life management strategy that has had an impact on the biome
- An explanation of issues with the management strategy
- A description of how you would make management of the biome more sustainable and equitable (fair for all)

Now consider the question:

- Is it possible for management of biomes to be sustainable and equitable?

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding, Criterion B: Investigating, Criterion C: Communicating and Criterion D: Thinking critically.

Do the positive effects of globalization outweigh its negative effects?



■ **Figure 12.8** Globalization: positive or negative?

ACTIVITY: An article on the impacts of globalization

■ ATL

- Communication skills: Use a variety of media to communicate with a range of audiences

You are a journalist working for an American magazine investigating the impacts of globalization.

Your editor has asked you to write a short analytical article about situations where some people embrace globalization and others reject it.

Search for relevant sources using the following terms: **anti-globalization**, **globalization** **globalism**, **pro-globalization**.

How will you achieve this?

- Use a wide range of sources of information to **evaluate** the impact of globalization, considering both the positive and negatives and different perspectives.

- How are different countries managing globalization? Is it working?

Once you have written your article, work in pairs. In turns, take the role of the editor to **evaluate** the article from your partner, using the following success criteria:

- Is there a good range of sources in the article?
- Have specific facts and figures from the sources been used to support the arguments?
- Is the article balanced and does it include different views, and why people think that way?
- Does the article explain clearly what the journalist thinks about how countries manage the impacts of globalization?

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion C: Communicating and Criterion D: Thinking critically.

To what extent does tourism aid equality in a country?

ACTIVITY: Writing about tourism and equality

■ ATL

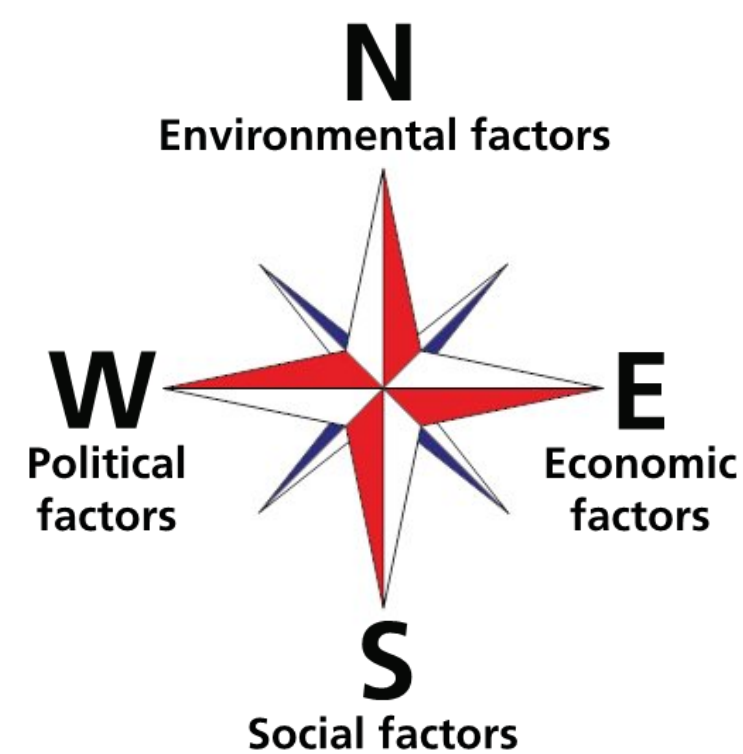
- Communication skills: Structure information in summaries, essays and reports

Your task is to write an extended answer to the following question: **To what extent** does tourism bring equality to the host region?

Use the Writing an extended answer box on page 290 to help you structure your answer.

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding, Criterion C: Communicating and Criterion D: Thinking critically.



■ Figure 12.9 Factors

Tourism can be one of the main forms of income for some countries. They rely on the tourism sector to provide investment in education, infrastructure, health care, etc. However, tourism can bring many issues for a country, such as water usage, child exploitation, seasonal jobs and inequality. The United Nations World Tourism Organization (UNWTO) promotes responsible and sustainable accessible tourism.

! Take action

■ ATL

- Information literacy skills: Access information to be informed and inform others

- ! Raise awareness of tourism and child exploitation either in your region or in another region. You may choose to start by looking at these websites:
 - ◆ <http://ethics.unwto.org/content/what-you-can-do-against-child-exploitation-tourism>
 - ◆ <http://ethics.unwto.org/content/protection-children-tourism>



■ Figure 12.10 Symbols of tourism



Writing an extended answer

You should organise your paragraphs in a logical structure.

Use the compass in Figure 12.9 to help you sort out your factors.

Organise the factors you have identified into the sections of the compass. If you feel that a factor overlaps two sections, you can position it in the middle, such as SE: socio-economic factors. You might not need all the compass points; you can just leave them blank.

Each paragraph should have a geographical aspect to it. You should make a point, then **explain** the point and then give evidence for the explanation. The last sentence should link back to the question. To help you with the activity on the previous page, you could follow the structure below.

Essay structure

Introduction

Give an opening statement that hooks the reader in and links to the question.

Define any key terms.

Tell the reader how you are going to answer the question (give the headings of the paragraphs) and what extended examples you will be using.

Paragraph one: Social factors

Positive social impacts of tourism for host region: what they are and examples.

Negative social impacts of tourism for host region: what they are and examples.

Last sentence: Which factors does the host region have more of, positives or negatives? Does tourism bring socio-cultural equality?

Paragraph two: Economic factors

Positive economic impacts of tourism for host region: what are they and examples.

Negative economic impacts of tourism for host region: what are they and examples.

Last sentence: Which factors does the host region have more of, positives or negatives? Does tourism bring economic equality?

Paragraph three: Environmental factors

Positive environmental impacts of tourism for host region: what are they and examples.

Negative environmental impacts of tourism for host region: what are they and examples.

Last sentence: Which factors does the host region have more of, positives or negatives? Does tourism bring environmental equality?

Conclusion

Summarize each paragraph: Does tourism bring equality in terms of socio-cultural, economic and environmental factors? What did you find out? What do you think? (Your opinion counts.)

Why is it so difficult to have a global sustainable response to climate change?

ACTIVITY: Government debate on climate change

■ ATL

- Creative-thinking skills: Practise flexible thinking – develop multiple opposing, contradictory and complementary arguments



■ **Figure 12.11** UN Sustainable Development Goal 13

You are going to take on two opposing roles:

- **Role one:** You are an official who is giving evidence to your government, which believes that climate change is real. You are presenting to the United Nations and your government wants you to convince leaders who are sceptical about whether or not climate change is really happening. You must give the evidence (the patterns and trends of the data) and **explain** why the evidence **shows** that climate change is really happening.
- **Role two:** You are an official for a government that believes that climate change is a hoax. You are **presenting** your evidence to the United Nations. You must give the evidence and **explain** why the evidence **shows** that climate change is not happening.

Why is it so difficult for governments to agree on the causes and issues surrounding climate change?

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion A: Knowing and understanding, Criterion B: Investigating, Criterion C: Communicating and Criterion D: Thinking critically.

! Take action: Moving forward

■ ATL

- Information literacy skills: Be informed and inform others

- ! Set up a class, year/grade or whole school version of the Model United Nations (MUN) to have a debate on how the powers are responding to the causes and consequences of climate change.
- ! Divide up your cohort into different countries. Each group will have to represent their country.
- ! You will need to investigate the country's current stance on climate change, and what its position is

on the Paris agreement. Write a speech on the issues according to the country you are representing.

- ! Then each country will give a speech on the issue of climate change and give some solutions.
- ! As a school community, what can you do to promote and take action against the causes and consequences of climate change?

◆ Assessment opportunities

- ◆ This activity can be assessed using Criterion D: Thinking critically.

Should hazard warning systems be equally available to all?

! Take action: Our risky world

■ ATL

- Information literacy skills: Collect, record and verify data
- Critical-thinking skills: Gather and organize relevant information to formulate an argument; Consider ideas from multiple perspectives

What is your goal?

- ! You are going to **investigate** the extent to which we all live in hazardous environments and whether there should be hazard warning systems where we reside. Think about the concepts of hazard perception, vulnerability and risk on pages 232–33. There is a high probability that you are exposed to potential hazards in your everyday activities and also that the place where you live could be affected by a range of natural hazards.

How will you achieve this?

- ! You are going to **design** a questionnaire to collect primary data about your friends' and family's exposure to frequent everyday hazards and less frequent natural hazards such as storms, flooding, drought or even tectonic hazards. You will also collect reliable secondary data sources to **identify** existing hazard warning systems in place at your school and in your friends' and family's places of residence.
- ! **Present** your findings in a format of your choice and then **analyse** your results in order to answer the following research question: 'Are our lives becoming more hazardous?'
- ! You could use the generic inquiry organizer on page 26 to guide you through your investigation.

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion A: Knowing and understanding, Criterion B: Investigating and Criterion D: Thinking critically.



■ **Figure 12.12** An everyday hazard

To what extent can technology limit the impact of tectonic hazards?

! Take action: Public awareness campaign

■ ATL

- Creative-thinking skills: Use brainstorming and visual diagrams to generate new ideas and inquiries
- Communication skills: Use a variety of media to communicate with a range of audiences



■ **Figure 12.13** Effective evacuation procedures result in reduced losses

- ! You are going to raise public awareness in a place of your choice about the importance of managing tectonic hazards by using a range of responses which include: community preparedness, evacuation plans, earthquake proof designs, land-use zoning in volcanic regions and insurance. Your chosen location should be located on or near a plate margin. Remember that the

type of margin will influence the range of hazards and this could potentially affect the range of responses.

- ! You are going to **create** a visual aid, such as an infographic or a poster, that **describes** and **explains** how to manage the tectonic processes and associated hazards and how to respond to the impacts they could have on people and businesses.

1 Select a location.

2 Use the generic inquiry organizer on page 26 to:

- Explore the tectonic processes and hazards in your chosen study area. Record the information that you found and how you found it.
- Investigate appropriate management responses for the hazards identified.
- Plan how you will organize and present your information. You should design a storyboard or use a sketch to draft your design.
- Create your presentation using an infographic website such as <https://piktochart.com/> or search online for **infographic maker**.
- Reflect on your inquiry. Use and refer to the information you have recorded throughout your inquiry.

◆ Assessment opportunities

- ◆ In this activity you have practised skills that are assessed using Criterion C: Communicating and Criterion D: Thinking critically.

Reflection

In this chapter, we have **explored** questions relating to how we can make the world a fairer place. We have **analysed** how technology can help us, when used appropriately. We have **taken action** by raising awareness of major issues that affect people around the world, who might not have the opportunity to do so.

Use this table to reflect on your own learning in this chapter.					
Questions we asked	Answers we found	Any further questions now?			
Debatable: To what extent is GIS a tool for sustainability and future planning? What must be considered when managing the population of a country? Can urban areas ever be managed sustainably? Can humans use technology to counter the impact of their activities on water systems? How can we meet our global consumption levels in the future? Is it possible for management of biomes to be sustainable and equitable? Do the positive effects of globalization outweigh its negative effects? To what extent does tourism aid equality in a country? Why is it so difficult to have a global sustainable response to climate change? Should hazard warning systems be equally available to all? To what extent can technology limit the impact of tectonic hazards?					
Approaches to learning you used in this chapter:	Description – what new skills did you learn?	How well did you master the skills?			
		Novice	Learner	Practitioner	Expert
Communication skills					
Creative-thinking skills					
Critical-thinking skills					
Information literacy skills					
Learner profile disposition	Reflect on the importance of being principled for your learning in this chapter.				
Principled					

Glossary

abiotic Non-living parts of an ecosystem, such as soil and air

abrasion The process of fine load/sediment scraping and wearing away the sides and banks of rivers

absorption Takes place when matter captures electromagnetic radiation, converting the energy of photons to internal energy

acid lava A viscous lava with high silica content

afforestation The act or process of establishing a forest, especially on land not previously forested

agglomeration Many urban areas that have grown into each other

albedo effect Where light surfaces reflect more heat than dark surfaces

altitude Height above sea level

anti-natalist policy A government policy that encourages people to have fewer children

apex The highest consumer in a trophic level

atmosphere The envelope of gases surrounding the Earth or another planet

attrition The process of smaller load or sediment knocking together and breaking up into smaller pieces

aurorae An atmospheric phenomenon consisting of bands, curtains or streamers of light, usually green, red or yellow, that move across the sky in polar regions. It is caused by collisions between air molecules and charged particles from the Sun that are trapped in the Earth's magnetic field

back radiation Radiation that is reflected back to the Earth's surface

backwash Waves moving back from the beach

balance of trade The difference in value between a country's imports and exports

base map A map used in GIS containing background information for orientation, measuring distances and height

basic lava A non-viscous lava with low silica content

biomass The total quantity or weight of organisms in a given area

biome A large, naturally occurring community of plants and animals occupying a major climatic region

biosphere The regions of the surface and atmosphere of the Earth or another planet occupied by living organisms

biotic Living parts of an ecosystem, such as plants and animals

child mortality rate The number of children under the age of five who die per 1,000 live births in a given year and area/country

choropleth map A map that uses differences in shading or colouring to represent average values in defined areas

comparative advantage theory When a country can produce one thing more efficiently and at a lower cost than another country due to favourable geographical conditions

contraception rate The percentage of women who are using, or whose sexual partner is using, at least one method of contraception (to prevent pregnancy). It is usually reported for women aged 15–49

constructive waves Waves that deposit sediment/material on the beach

contour line A line on a map joining points of equal height above sea level

conurbation Several smaller urban areas that have developed into one large urban area

convection current A current resulting from heat transfer in the Earth's mantle

corrasion See *abrasion*

corrosion Where water dissolves the load/sediment and is carried as a solution

crude birth rate The number of live births per 1,000 population in a given area

crude death rate The number of deaths per 1,000 population in a given area

cryosphere The frozen water part of the Earth's system

data visualization The representation of information in the form of a chart, diagram, map or picture

decomposer An organism, for example soil bacterium, fungus or invertebrate, that decomposes organic material, such as trees

deforestation The cutting down of forests

demography The study of statistics such as births, deaths, income, incidence of disease, which illustrate the changing structure of human populations

dependent variable A variable whose value depends on that of another

deposition Where materials from water cannot be transported any more due to the lack of energy

destructive waves Waves that erode sediment/material from the beach

disaster A sudden event that seriously disrupts the functioning of a community and causes human, material and economic or environmental losses

discharge The amount of water passing a point along the river. It is measured in m³/sec, or cumecs

doubling time The time it takes for a country to double its population

ecotourism Tourism directed towards exotic natural environments, intended to support conservation efforts and observe wildlife

ecological footprint The impact of human activity on the environment, expressed as the amount of land required to sustain our use of natural resources

economic multiplier effect The introduction of a new industry or the expansion of an existing industry in an area, which also encourages growth in other industrial sectors. Also known as cumulative causation

economy of scale The cost reduction experienced by a company when it increases its level of production

emigration/emigrating The process of people leaving a country

emission The production and discharge of something, especially gas or radiation

energy budget The balance sheet of energy income against expenditure

enhanced greenhouse effect An increase in the concentration of greenhouse gases in the atmosphere which results in more heat being retained and an overall warming of the Earth's temperature, due to human activities

epiphytes A plant that grows on another plant, but is not parasitic

erosion The wearing away of the land by water, wind or other natural agents

fauna Animals of a particular area

female infanticide The deliberate killing of baby girls due to a preference for male babies

fertility rate The average number of children a woman will have in her lifetime

flora Plants of a particular area

food web A system of interdependent food chains

gentrification The process of improving or renovating an area that conforms to more middle-class tastes

Geographic Information System (GIS) A computer system designed to process, analyse and present geographic data on digital maps

geolocated Information that can be identified by its real-world geographic location using Global Positioning System (GPS) technology

geology The scientific study of the Earth, including the rock materials of the crust, the structure of those materials and the processes affecting them

geophysical processes Naturally occurring physical processes at the surface of the Earth

gradient An inclined part of land or slope of a graph

greenhouse effect A phenomenon caused by gases naturally present in the atmosphere that affect the behaviour of the heat energy radiated by the Sun

Gross Domestic Product (GDP) The total value of all the finished goods and services produced within a country's borders within one year

Gross National Income (GNI) A measure of a country's income. GNI includes net income received from abroad

Gross National Product (GNP) The total value of goods produced and services provided by a country during one year (now known as Gross National Income)

habitat The natural home or environment of an animal, plant or other organism

herbivore Animal that only eat plants

high-income country A country that has a Gross National Income (GNI) of over US\$12,056 per person/capita per year

hydraulic action The sheer force of the water eroding the banks and beds of a river channel

hydrograph A graph representing the rate of flow and the amount of precipitation over a period of time

hydrosphere All the waters on the Earth's surface, such as lakes and seas

hygrometer An instrument for measuring the humidity of the air or a gas

igneous rock Rocks that form when liquid magma cools, creating crystal structured rocks

immigration/immigrating The process of people moving into a country

imperialism A policy of extending a country's power and influence through colonization, use of military force or by other means

incident energy A measurement of energy, usually heat, striking a surface

independent variable A variable whose value does not depend on that of another

indigenous Originating from a particular place

infant mortality rate The number of children under the age of one who die per 1,000 live births in a given year and area/country

infra-red radiation Region of the electromagnetic radiation spectrum with wavelengths from about 700 nm to 1 nm

infrastructure The fundamental structure and facilities that an area needs, such as roads, electricity, buildings

lag time The difference between peak precipitation and peak discharge, in a hydrograph

land grabbing When land is taken over by governments, companies or individuals for economic reasons

land use Different uses of the land by humans

life expectancy The average age a person is expected to live until

litter Dead matter from plants

load See *sediment*

longshore drift The process of material being transported along a beach due to waves hitting the beach at an angle

low air pressure A condition of the atmosphere in which the pressure is below average

low-income country (LIC) A country that has a Gross National Income (GNI) of US\$955 and below per person/capita per year

manufactured products Goods made using raw materials

mass tourism A form of tourism that involves many people going on holiday to the same location, often at the same time

meander A bend in a river

megacity A very large city, typically one with a population of over 10 million people

mesosphere The region of the Earth's atmosphere above the stratosphere and below the thermosphere, between about 50 and 80 km in altitude

middle-income country (MIC) A country that has a Gross National Income (GNI) of US\$996–12,055 per person/capita per year

mitigation The action of reducing the severity of something

mouth The end of the river, where it flows into the sea, ocean or lake

negative feedback loop A reaction that causes a decrease in part of a system's function; this tends to hold a system to some equilibrium, making it more stable

nutrient cycle The movement of biotic (organic) biomass and abiotic inorganic matter in an ecosystem. The process is regulated by the food web, in which organic matter such as leaf litter and dead plants and animals are decomposed into inorganic nutrients and into the soil. Nutrient cycles occur within ecosystems

orbital plane The plane of a planet's orbit around the Sun

overpopulation When there are too many people for the available resources

ozone A colourless, unstable toxic gas with a pungent odour and powerful oxidizing properties, formed from oxygen by electrical discharges or ultraviolet light

pattern How events, information or processes are arranged in a given geographic area

permafrost A thick subsurface layer of soil that remains below freezing point throughout the year, occurring chiefly in polar regions

pH The acidity or alkalinity of a solution

population pyramid A bar graph that shows the breakdown of various age groups by gender in a population

positive feedback loop A reaction that enhances or amplifies changes; this tends to move a system away from its equilibrium state and make it more unstable

primary consumer The second level of the trophic level. Animals that are herbivores

primary tourism resources Resources that exist, or originally existed, for non-tourist purposes

pro-natalist policy A government policy that encourages people to have larger families

producers Organisms that make their own food, such as plants. The first level of the trophic level. Also known as autotrophic

pull factors The positive reasons why people want to move to a place

push factors The negative reasons why people want to leave a place

quota A limit on the production, export or import of goods and raw material

range of goods and services The variety of goods and services that a settlement provides

reflection When heat is bounced or reflected off an object

regeneration A process of improving an area

relief The difference in height between the high and low points in an area

remittance A sum of money sent in payment or as a gift

return period An estimate of the likelihood of an event of a certain size, such as an earthquake or a flood, occurring

rising limb The increase of discharge in a river in a hydrograph. The steeper the rising limb, the quicker the discharge increases

saltation Small load being transported in a river, bouncing up and down along the river bed

scale bar A line showing distances on a map using various measurement units

secondary consumers Animals that eat primary consumers

secondary tourism resources Resources that have been built for tourism, such as hotels

sediment Material deposited by rivers, wind or ice

settlement hierarchy How settlements are placed in terms of either importance or population size

shanty town An informal area of the city that has illegal housing, usually associated with people on very low incomes. Also known as favelas in South America, and bustees in India

silica A colourless and white mineral commonly found in the Earth's crust (also known as silicon dioxide)

solution Load that has been dissolved in the river and is being transported downstream

source The beginning of a river, usually in the highland area of the watershed

spatial Relating to land and space

spatial analysis A type of geographical analysis which seeks to explain patterns shown on maps or digital imagery

spatial distribution See *pattern*

sphere of influence How far someone is willing to travel to a settlement, or area for buying goods or services

stakeholder A person with an interest or concern in something

stratosphere The layer of the Earth's atmosphere above the troposphere, extending to about 50 km above the Earth's surface

subsidy A sum of money given by a government to help an industry or business keep the price of its products low

supranational organization A union where governments or member states delegate power to an international organization or authority

suspension Fine load that is transported in a river

sustainability Meeting our own needs without compromising the ability of future generations to meet their needs

swash Waves moving up the beach

tectonic processes Physical processes within the Earth's crust resulting from the movement of tectonic plates

temporal Relating to time and timescales

tertiary consumer Animals that eat secondary consumers and are close to being the apex consumer

think tank A group of experts providing advice and ideas on specific political or economic problems

tourism enclave An area, the purpose of which is only tourism; the surrounding area receives no benefit from it

traction Large load rolling along the bed of a river

trade deficit When a country's imports exceed its exports

transportation The process of the river moving the load downstream

tributaries Small rivers that flow into large rivers

trophic level Any class of organism that occupies the same position in a food chain, as primary consumers, secondary consumers or tertiary consumers

troposphere The lowest region of the atmosphere, extending from the Earth's surface to a height of about 6–10 km

ultraviolet radiation The part of the electromagnetic spectrum where wavelengths are just shorter than those of ordinary, visible violet light but longer than those of x-rays

urbanization The process of an area becoming urban (like a city) as its population grows

vulnerability The possibility of being harmed, either physically or emotionally, by an external event

vulnerable population A group of people that requires greater protection than other groups

zooification The process of indigenous people being integrated with the dominant society purely as objects of curiosity for the tourism industry

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